Essais sur les transferts internationaux des migrants: une approche macroéconomique

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Essays on international remittances : A macroeconomic approach

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Résumé

Cette thèse apporte quatre essais sur les transferts internationaux des migrants, en utilisant une approche macroéconomique. Le premier essai examine empiriquement, sur 14 pays d'Amérique Latine et des Caraïbes, les déterminants macroéconomiques des transferts des migrants. Les trois autres essais portent sur les effets macroéconomiques des transferts des migrants sur les économies des pays en développement. Le deuxième essai évalue quantitativement la contribution des chocs de transferts des migrants dans la fluctuation macroéconomique du Sénégal, en utilisant un modèle d'équilibre général dynamique stochastique. Le troisième essai examine l'effet des transferts sur le taux de change réel en menant une étude empirique sur les pays de la zone Franc CFA. Finalement, le quatrième essai étudie empiriquement l'effet des transferts des migrants sur la volatilité macroéconomique de 87 pays en développement en mettant un accent particulier sur l'interaction entre les transferts et le développement financier.

Mots clés : transferts internationaux des migrants ; pays d'accueil ; pays d'origine ; conjoncture macroéconomique ; croissance économique ; taux de change réel ; volatilité macroéonomique ; développement financier.

Abstract

This thesis brings four contributions to the literature on international remittances, using a macroeconomic approach. The first contribution empirically examines the macroeconomic determinants of remittances by investigating the response of remittances to the macroeconomic conditions of host and home countries, using panel data on 14 Latin American and Caribbean countries. The other three contributions are about the macroeconomic impacts of remittances. The second essay quantitatively evaluates the role of remittance shocks in explaining the macroeconomic fluctuations of Senegal, using a dynamic stochastic general equilibrium (DSGE) model. The third contribution empirically investigates the impact of remittances on real exchange rate, using panel data on CFA Franc zone countries. Finally, the fourth essay empirically examines the effect of remittances on macroeconomic volatility of 87 developing countries with a particular focus on the interaction between remittances and financial development.

Keywords : international remittances ; host country ; home country ; business cycles ; economic growth ; real exchange rate ; macroeconomic volatility ; financial development.

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Bien sûr, les erreurs et maladresses qui pourraient apparaître dans cette thèse demeurent entièrement les miennes.

A ma mère

Dramane Coulibaly

Paris le 18 juin 2010

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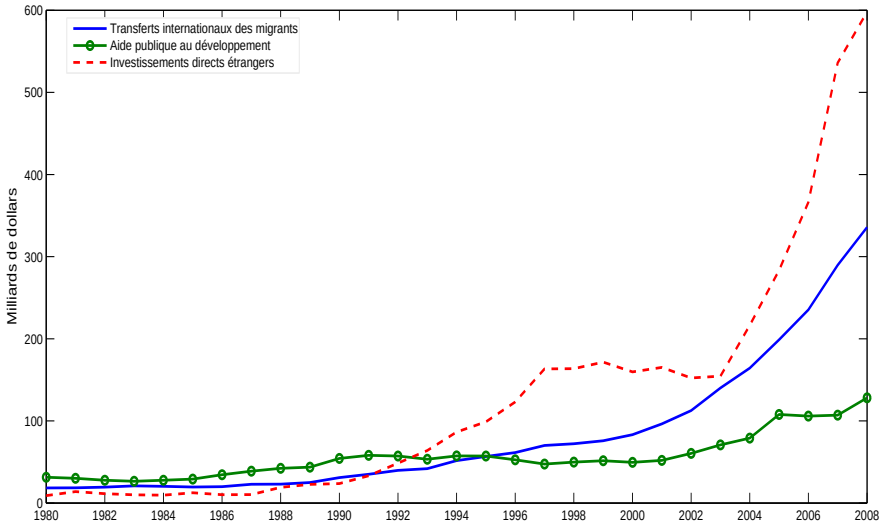
Introduction

Les deux dernières décennies ont été marquées par une augmentation drastique du montant des transferts des migrants reçus dans les pays en développement. Au niveau agrégé, les transferts reçus des migrants ont surpassé l'aide publique étrangère et sont devenus la deuxième source de flux d'échange internationaux après les investissements directs étrangers. Les transferts des migrants ont augmenté, entre 1980 et 2008, de 25 milliards de dollars à 338 milliards de dollars (Figure 1), soit une augmentation de 1220% (source : Banque Mondiale, 2009).

Dans beaucoup de pays en développement, les transferts des migrants représentent une part importante de leurs revenus. Par exemple, en 2008 dans les 25 pays qui sont les plus gros receveurs (Figure 2), les transferts des migrants représentent environ 45% du PIB au Tadjikistan, 39% du PIB au Tonga, 34% du PIB en Moldavie, 28% du PIB au Lesotho, 26% du PIB au Guyana, 24% du PIB au Liban, 23% du PIB au Samoa, 22% du PIB en Jordanie et à Honduras, 20% du PIB en République Kirghize, 19% du PIB en Jamaïque, 18% du PIB en El Salvador, et Haïti, 17% du PIB au Népal et en Bosnie-Herzégovine, 13% du PIB au Nicaragua et au Guatemala, 12% du PIB en Serbie, 11% du PIB aux Philippines, 10%

FIGURE 1 – Flux internationaux de capitaux

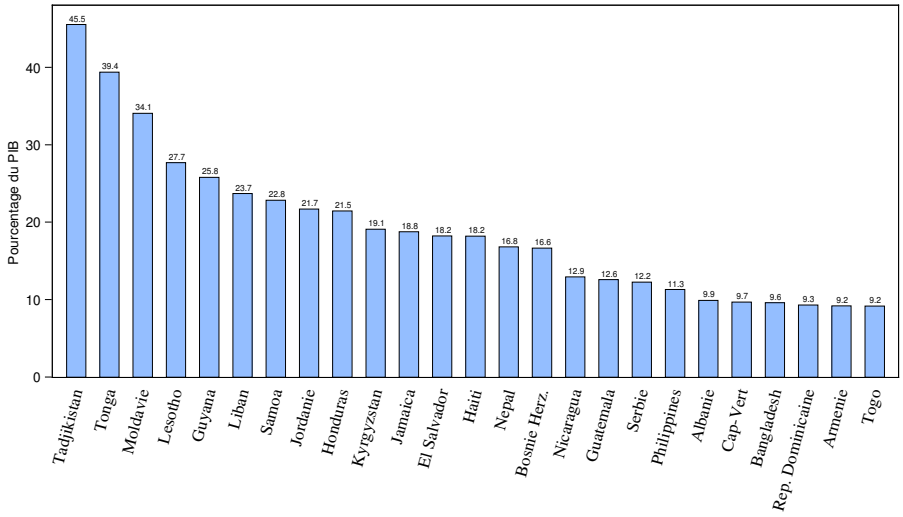


Source : Banque Mondiale, 2009

du PIB en Albanie, au Cap-Vert et au Bangladesh, 9% du PIB en République Dominicaine, en Arménie et au Togo.

Comme les transferts des migrants affectent la vie de beaucoup d'individus à travers le monde, les économistes ont examiné les déterminants des transferts des migrants dans un cadre théorique et empirique. D'autre part, les économistes ont essayé d'évaluer les effets des transferts des migrants sur les économies des pays en développement. Après avoir exposé la revue de littérature sur les transferts des migrants (Chapitre 1), cette thèse apporte quatre contributions à cette littérature. La première contribution (Chapitre 2) porte sur les déterminants macroéconomiques des transferts et les trois autres contributions (Chapitres 3, 4 et 5) portent sur les effets macroéconomiques des transferts. Le chapitre 2 examine la réaction des transferts des migrants aux conditions macroéconomiques dans les pays d'accueil et dans les pays d'origine, en utilisant une approche vectorielle autorégressive (Vector

FIGURE 2 – Les 25 pays les plus gros receveurs des transferts des migrants



Source : Banque Mondiale, 2009

Autogressive, VAR) en panel. D'une part, les conditions économiques dans l'accueil des migrants déterminent la capacité des migrants d'envoyer de l'argent. D'autre part, la réponse des transferts à une amélioration des conditions économiques du pays d'origine dépend si les transferts sont altruistes ou égoïstes (recherche d'intérêt personnel). Le chapitre 3 évalue quantitativement la contribution des chocs des transferts des migrants dans la fluctuation macroéconomique du pays receveur des transferts en utilisant un modèle DSGE (Dynamic Stochastic General Equilibrium) à petite économie ouverte. En effet, les transferts n'étant pas forcément stables et pouvant être expliqués par des facteurs exogènes d'un point de vue du pays receveur des transferts (notamment par des conditions économiques du pays d'accueil des migrants), les transferts peuvent être considérés comme une source de fluctuations dans le pays receveur des transferts à travers ses effets macroéconomiques notamment l'effet Dutch disease (le syndrome du mal hollandais). Les transferts des migrants, comme

n'importe quel autre flux de capitaux internationaux, peuvent conduire à un effet Dutch disease qui est défini comme étant une appréciation du taux de change réel associé au déclin du secteur exportateur. Le chapitre 4 examine l'effet Dutch disease (appréciation du taux de change réel) provoqué par les transferts des migrants dans un cadre monétaire en utilisant un modèle monétaire à petite économie ouverte. Contrairement au modèle du chapitre 3, le modèle du chapitre 4 est non stochastique. Dans le chapitre 4, l'accent est mis sur le fait que l'effet des transferts sur le taux de change réel à court terme dépend du régime de change. Ainsi, le chapitre 4 examine empiriquement l'effet des transferts sur le taux de change réel des pays de la zone Franc CFA qui sont en union monétaire et en change fixe vis-à-vis de l'euro (du Franc français avant 2002). Contrairement aux chapitres 3 et 4, le chapitre 5 porte sur un aspect positif des transferts des migrants. Le chapitre 5 étudie empiriquement l'effet des transferts des migrants sur la volatilité macroéconomique dans les pays en développement en mettant un accent particulier sur l'interaction des transferts avec le développement financier. Les transferts des migrants constituent une ressource permettant de lisser la consommation et l'investissement et ils permettent ainsi de réduire la volatilité macroéconomique comme le fait le développement financier. Cependant, un niveau très élevé des transferts peuvent induire les ménages receveurs à choisir des projets risqués ou à fournir moins d'effort pour vérifier la qualité des projets. Un système financier bien développé, en donnant de l'information, peut éviter d'investir les transferts dans des investissements risqués. Ainsi, un système financier bien développé permet aux transferts des migrants de n'avoir que des effets stabilisateurs.

Réaction des transferts des migrants aux conditions macroéconomiques dans les pays d'acceuil et dans les pays d'origine

Motivation

La littérature sur les déterminants des transferts des migrants est basée sur deux approches : une approche microéconomique et une approche macroéconomique. Dans l'approche microéconomique, Lucas and Stark (1985) ont été les premiers a examiné dans un cadre théorique les déterminants des transferts des migrants. Ces auteurs ont montré que les décisions de transferts d'argent des migrants peuvent être expliquées par plusieurs raisons allant de l'altruisme pur à l'égoïsme pur (recherche d'intérêt personnel). Selon Lucas and Stark (1985), les transferts sont altruistes s'ils augmentent avec le revenu de la famille restée dans le pays d'origine du migrant, tandis que les transferts sont classés comme égoïstes (recherche d'intérêt personnel), s'ils augmentent avec une amélioration des conditions économiques du pays d'origine. Certaines études (Lucas and Stark, 1985 ; Ilahi and Jafarey, 1999 ; Agarwal and Horowitz, 2002 ; Adams, 2009) ont testé dans un cadre microéconomique l'hypothèse d'altruisme contre l'hypothèse d'égoïsme. Globalement, les évidences empiriques issues des études microéconomiques montrent que les transferts sont plus expliqués par des arrangements familiaux plus que par l'altruisme ou toute autre considération individualiste.

En même temps, d'autres études ont examiné les déterminants des transferts dans un cadre macroéconomique. Pour capturer les conditions économiques du pays d'accueil des migrants, le PIB du pays d'accueil est généralement utilisé. Elbadawi and Rocha (1992), El-Sakka and McNabb (1999) et Lianos (1997) ont trouvé un effet positif du PIB du pays

d'accueil sur le montant des transferts. Certaines études ont aussi utilisé le taux de chômage dans le pays d'accueil pour capturer les conditions économiques du pays d'accueil. Higgins et al. (2004) ont trouvé un effet positif de cette variable sur les transferts, tandis que, Lianos (1997) a trouvé un effet ambigu.

Pour capturer les conditions économiques du pays d'origine (pour motif d'altruisme), le PIB du pays d'origine est généralement considéré. L'intuition est que, en raison d'altruisme, les migrants enverront plus d'argent si la condition économique du pays d'origine se détériore. Les résultats existant ont mis en évidence un effet ambigu de cette variable. Par exemple, El-Sakka and McNabb (1999) et Elbadawi and Rocha (1992) ont trouvé que le PIB du pays d'accueil n'a pas d'effet significatif sur les transferts.

Pour mettre en évidence les motifs d'égoïsme, certaines études ont utilisé des variables capturant la différence des rendements des actifs (taux d'intérêt) dans les pays d'accueil et d'origine. Swamy (1981) et Elbadawi and Rocha (1992) ont trouvé que la différence de taux d'intérêt n'est pas significative, tandis que, El-Sakka and McNabb (1999) ont trouvé un effet négatif significatif. Lianos (1997), en utilisant séparément le taux d'intérêt du pays d'accueil et ce du pays d'origine, a trouvé un effet positif du taux d'intérêt du pays d'origine, mais un effet ambigu du taux d'intérêt du pays d'accueil.

Les techniques utilisées dans les articles mentionnés ci dessus, sont généralement des estimations des équations uniques. Pour tenir compte des problèmes d'interactions entre les transferts et ses déterminants potentiels, Huang and Vargas-Silva (2006) ont utilisé un modèle autorégressif vectoriel (VAR). Dans ce cadre de modèle vectoriel, Huang and Vargas-Silva (2006) ont examiné si les transferts répondent plus aux facteurs macroéconomiques du pays d'accueil qu'aux facteurs macroéconomiques du pays d'origine. Les auteurs

ont utilisé dans leur système vectoriel, les transferts envoyés des Etats-Unis d'Amérique (ou transferts reçus au Mexique), des variables capturant les conditions économiques des Etats Unis d'Amérique (PIB, taux d'intérêt de la réserve fédérale, la croissance de la masse monétaire, inflation), variables capturant l'activité économique (PIB, inflation) du Mexique (ou une moyenne pondérée de ces variables pour les cinq pays plus grands receveurs des transferts provenant des Etats-Unis d'Amérique : le Mexique, le Brésil, la Colombie, l'EL Salvador et la République Dominicaine). Les auteurs ont trouvé des évidences suggérant que les transferts des migrants réagissent plus aux conditions économiques du pays d'accueil (Etats-Unis d'Amérique).

La première contribution (Chapitre 2) de cette thèse continue dans la lignée de l'étude de Huang and Vargas-Silva (2006). Contrairement à Huang and Vargas-Silva (2006), le chapitre 2 de cette thèse examine la réponse des transferts aux conditions économiques dans les pays d'accueil et dans les pays d'origine en utilisant une approche VAR en panel. L'utilisation du VAR en panel permet de bénéficier à la fois de l'avantage du modèle VAR et de l'avantage des données de panel. L'approche VAR traite le problème d'endogénéité (causalité) en permettant une interaction endogène entre les variables du système. La causalité entre les transferts et ses déterminants potentiels se pose. En effet, les transferts sont affectés par les conditions économiques du pays d'origine, en même temps, les transferts peuvent influencés la consommation, l'investissement et la croissance dans le pays d'origine. L'utilisation des données de panel permet de résoudre le problème de rareté des données des pays en développement et les résultats asymptotiques découlent facilement des données de panel.

Modèle théorique

Avant l'estimation empirique, le chapitre 2 présente un modèle théorique montrant les déterminants potentiels des transferts. Le modèle théorique est un modèle simple à deux périodes dans lequel le migrant représentatif est né dans le pays d'origine et travaille dans le pays d'accueil. La fonction d'utilité du migrant est supposée dépendre de sa propre consommation de la première et de la deuxième périodes, de la consommation de la famille dans le pays d'origine (pour motif d'altruisme). La consommation de la famille est supposée dépendre du revenu de la famille dans le pays d'origine et des transferts reçus de la part du migrant. Dans la première période, le migrant maximise son utilité en allouant son revenu entre les transferts de soutien à la consommation de sa famille dans le pays d'origine, sa propre consommation dans le pays d'accueil, et son épargne (ou investissement). Le migrant peut investir dans le pays d'accueil comme dans le pays d'origine. Dans la seconde période, le migrant consomme l'investissement de la seconde période (et son rendement).

Le problème du migrant peut être décomposé en deux étapes. La première étape du programme du migrant consiste à allouer son revenu entre sa propre consommation, l'épargne et les transferts de soutien à la consommation de sa famille. La seconde étape consiste à allouer le montant d'épargne choisi dans la première étape entre l'investissement dans le pays d'accueil et l'investissement dans le pays d'origine en fonction de leurs rendements respectifs. Par simplicité on suppose qu'il n'existe pas de coût de transferts.

Les résultats montrent que les transferts envoyés pour soutenir la consommation de la famille dépendent positivement du revenu du migrant et négativement du revenu de la famille. En d'autres termes, en raison du motif d'altruisme, le migrant enverra plus

d'argent si son revenu augmente ou si le revenu de sa famille baisse. Les résultats montrent aussi que le montant des transferts envoyés pour des motifs d'exploitation d'opportunité d'investissement (motif d'égoïsme) dépend positivement de la différence de rendement des actifs entre pays d'origine et pays d'accueil.

D'un point de vue macroéconomique, ces résultats signifient que le montant des transferts altruistes dépend négativement de l'amélioration des conditions économiques dans le pays d'accueil et de la détérioration des conditions économiques dans le pays d'origine. Le montant des transferts envoyés pour des motifs d'exploitation d'opportunité d'investissement dépendent positivement de l'amélioration des conditions économiques dans le pays d'accueil (reflétant une augmentation du rendement des actifs dans le pays d'accueil). Par conséquent, le montant total des transferts, étant la somme des transferts altruistes et des transferts d'exploitation d'opportunité d'investissement, dépend positivement de l'amélioration des conditions économiques dans le pays d'accueil. Par contre, la relation entre le montant total des transferts et les conditions économiques du pays d'origine dépendra du degré d'altruisme du migrant.

Données et résultats empiriques

Pour tester les prédictions du modèle théorique, le modèle VAR en panel est estimé sur des données annuelles de 1990 à 2007 issues de 14 pays d'Amérique Latine et des Caraïbes (le Belize, la Bolivie, la Colombie, la République Dominicaine, l'Equateur, l'El Salvador, le Guatemala, le Guyana, l'Haïti, le Honduras, la Jamaïque, le Mexique, le Nicaragua, et le Pérou). Ces pays ont été sélectionnés pour faciliter le choix du pays d'accueil des migrants. En effet, les Etats-Unis sont utilisés comme le seul pays d'accueil, car les Etats-Unis sont

la destination majeur des migrants provenant de ces 14 pays .

Pour capturer les conditions économiques du pays d'accueil (les Etats-Unis), le PIB des Etats-Unis et le taux d'intérêt de la réserve fédérale sont utilisés. Le PIB des Etats-Unis est utilisé pour refléter les changements du revenu des migrants. Le taux d'intérêt de la réserve fédérale est utilisé pour refléter les anticipations sur l'économie américaine. Le taux d'intérêt de la réserve fédérale peut affecter les transferts à travers deux canaux contradictoires. D'une part, une augmentation du taux d'intérêt de la réserve fédérale (contraction monétaire) entraine une baisse de la croissance américaine et donc une baisse des transferts. D'autre part, une augmentation du taux d'intérêt de la réserve fédérale a un effet positif sur les rendements des actifs américains conduisant à une baisse des transferts envoyés vers le pays d'accueil pour motif d'exploitation d'opportunité d'investissement. Pour capturer les conditions économiques du pays d'origine, le PIB du pays d'origine est utilisé. Comme mentionné ci-dessus, le PIB du pays d'origine peut avoir un effet ambigu si les transferts sont envoyés à la fois pour motif d'altruisme et pour motif d'exploitation d'opportunité d'investissement.

Les résultats des réponses d'impulsions (impulse response function, IRF) montrent que les transferts reçus répondent positivement à la croissance économique américaine et négativement au taux d'intérêt de la réserve fédérale. Par contre, la réponse des transferts à la croissance dans les pays d'origine n'est pas significative. Les résultats de l'analyse de la décomposition de la variance montrent que la part des variables capturant l'économie américaine dans la fluctuation des transferts est très élevée, soit 33% (26% pour le PIB et 7% pour le taux d'intérêt de la réserve fédérale (pour un horizon de 10 années). Par contre, la part du PIB des pays d'accueil n'est que de 4% (pour un horizon de 10 années).

Transferts des migrants, taux de change réel et fluctuations macroéconomiques dans les pays en développement

Motivation

D'un point de vue macroéconomique, les déterminants des transferts sont les conditions économiques du pays d'origine des migrants et du pays d'accueil des migrants. Les transferts des migrants sont considérés comme une combinaison d'altruisme et d'égoïsme (recherche d'exploitation d'opportunité d'investissement). Les transferts seront contracycliques à l'économie du pays receveur des transferts, si les motifs altruistes prédominent, tandis qu'ils seront procycliques à l'économie du pays receveur des transferts, si les motifs d'égoïsme prédominent. Les études empiriques n'ont pas donné de résultats unanimes sur la cyclicité des transferts. Comme le montre le chapitre 2, les transferts semblent ne pas répondre à l'économie du pays d'origine. Par contre, les études empiriques sont unanimes sur le fait que les transferts répondent aux conditions économiques du pays d'accueil. Autrement dit, il existe une composante des transferts qui est exogène du point de vue de l'économie du pays receveur des transferts. Dans la mesure où les transferts constituent une part importante du revenu de certains pays et peuvent avoir des impacts macroéconomiques, il semble donc intéressant de déterminer la contribution de ces chocs de transferts exogènes dans la fluctuation macroéconomique de l'économie du pays receveur des transferts. C'est le but du chapitre 3. Le chapitre 3 examine la contribution des chocs des transferts dans la fluctuation macroéconomique en utilisant un modèle dynamique stochastique calibré sur l'économie du Sénégal. Le Sénégal est choisi pour deux raisons principales. D'une part, les transferts sont relativement élevés au Sénégal, ils ont augmenté, entre 1990 et 2007, de

2.5% du PIB à 8.5% du PIB. D'autre part, grâce à sa capacité administrative le Sénégal dispose des données sectorielles nécessaires à cette étude.

L'étude dans le chapitre 3 est reliée à certaines études antérieures portant sur les sources de fluctuations des économies des pays en développement, telles que Mendoza (1995), Kose and Riezman (2001), et Kose (2002). Mendoza (1995) examine l'importance des chocs des termes d'échange en utilisant un modèle à petite économie ouverte calibrée sur un pays typique qui est en développement. L'étude de Mendoza (1995) a montré que les chocs des termes d'échange expliquent la moitié des fluctuations du PIB. Kose and Riezman (2001) ont étendu le modèle de Mendoza aux économies des pays africains et ils ont aussi montré que les chocs des termes d'échange expliquent la moitié des fluctuations macroéconomiques des économies africaines. En utilisant le même modèle de Mendoza (1995), Kose (2002) a montré que les chocs des prix mondiaux expliquent une très grande part de la fluctuation économique des pays en développement. Le chapitre 3 contribue à cette littérature sur les sources des fluctuations macroéconomiques des pays en développement en considérant les chocs de transferts des migrants comme source de fluctuations à travers leurs impacts macroéconomiques, notamment l'effet Dutch disease (syndrome ou mal hollandais).

Modèle théorique et résultats de la simulation

Le modèle utilisé dans ce chapitre est un modèle dynamique stochastique à trois biens (biens exportables, biens importés, et biens non échangeables). Dans ce modèle, la fonction d'utilité de l'agent représentatif dépend de sa consommation et du loisir (offre de travail). La consommation agrégée est composée de la consommation du bien exportable, du bien importé et du bien non échangeable. L'agent représentatif peut détenir des actifs étran-

gers à un taux d'intérêt exogène, peut investir en capitaux utilisés dans les productions domestiques (biens exportables et biens non échangeables). L'agent représentatif reçoit des transferts des migrants travaillant à l'étranger.

Le bien exportable est supposé être le bien primaire. La technologie de production du bien exportable utilise le travail, le capital importé, et la terre. La terre est utilisée dans la technologie de production du bien exportable, car la production du bien primaire nécessite une grande quantité de terre en Afrique (en particulier au Sénégal). Comme souligné par Kose and Riezman (2001), l'utilisation de la terre dans la technologie de production réduit la volatilité de la production du bien exportable et permet donc au modèle de reproduire la volatilité réaliste de l'économie Sénégalaise.

La technologie du bien non échangeable utilise le travail, le capital produit localement et un bien intermédiaire importé.

Les sources de fluctuations (chocs exogènes) considérées dans le modèle sont : les deux chocs de productivité domestiques (bien exportable et bien non échangeable), chocs des termes d'échange, chocs de taux d'intérêt réel mondial et chocs des transferts des migrants. A l'exception du taux d'intérêt, ces chocs sont estimés sur les données de l'économie sénégalaise. Le taux d'intérêt réel mondial est estimé par le taux d'intérêt du Bon du Trésor américain déflaté par l'inflation américaine. Les chocs sont estimés dans un processus vectoriel d'ordre 1, et ensemble, pour tenir compte de leurs corrélations. En outre, ceci permet de tenir compte de la contracyclité ou de la procyclicité éventuelle des transferts sans donner à priori un motif altruiste ou égoïsme des transferts.

Le modèle est capable de reproduire les propriétés de l'économie du Sénégal (volatilité, persistance et corrélation des variables macroéconomiques).

Le mécanisme par lequel les chocs de transferts des migrants affectent l'économie est le suivant. Une augmentation des transferts reçus des migrants travaillant à l'étranger conduit à une hausse du revenu du ménage receveur des transferts. La hausse du revenu entraine une augmentation de la demande de bien de consommation agrégée et une baisse de l'offre de travail du ménage. La baisse de l'offre de travail pousse les salaires à la hausse. L'augmentation de la demande de consommation agrégée pousse à la hausse le prix relatif des biens non échangeables, car l'offre des biens non échangeables est moins élastique que les biens échangeables (ceux-ci pouvant être importés). L'augmentation du prix relatif des biens non échangeables représente une appréciation du taux de change réel. L'appréciation du taux de change réel conduit à une réallocation de la main d'oeuvre vers le secteur des biens non échangeables (dont leurs prix augmentent) au détriment du secteur exportateur. Par conséquent, on assiste à une expansion du secteur des biens non échangeables et à un déclin du secteur exportateur. Le déclin du secteur exportateur est magnifié par la hausse des salaires provoquée par la baisse de l'offre de travail. Au total, la production domestique agrégée de l'économie baisse.

Pour déterminer la part de chaque choc dans la fluctuation macroéconomique du Sénégal, une analyse de la décomposition de la variance est effectuée. Cette analyse de la décomposition de la variance montre que les chocs des termes d'échange expliquent environ 61% de la fluctuation du PIB du Sénégal. Les chocs de taux d'intérêt mondial expliquent seulement 2% de la fluctuation du PIB du Sénégal. Les chocs de productivité du bien exportable expliquent environ 27% de la fluctuation du PIB du Sénégal, tandis que les chocs de productivité du bien non échangeable ont une part insignifiante dans la fluctuation du PIB du Sénégal. Le résultat original de ce chapitre est la contribution des chocs de transferts

des migrants dans la fluctuation macroéconomique. Les résultats montrent que les chocs de transferts des migrants expliquent environ 10% de la fluctuation du PIB du Sénégal. En outre, les résultats montrent aussi que environ 20% de la fluctuation du taux de change réel du Sénégal est expliquée par les chocs de transferts.

Transferts des migrants, taux de change réel : une évidence sur les pays de la zone Franc CFA

Motivation

Certaines études ont fourni des évidences empiriques que les transferts des migrants peuvent promouvoir le développement économique (réduction de la pauvreté, amélioration du système financier, augmentation de la croissance) (Adams and Page, 2005 ; Aggarwal et al., 2006 ; Acosta et al., 2008 ; Giuliano and Ruiz-Arranz, 2009). Cependant, d'autres études empiriques (Amuedo-Dorantes and Pozo, 2004 ; López et al., 2007) ont trouvé qu'une augmentation des transferts des migrants peut conduire à un effet Dutch disease (i.e. une appréciation du taux de change réel accompagnée d'une réallocation des ressources vers le secteur des biens non échangeables au détriment du secteur des biens échangeables) comme mentionné dans le chapitre 3.

Un problème se pose en examinant la relation entre le taux de change réel et les transferts des migrants. L'effet des transferts des migrants (comme n'importe quel autre flux de capital) dépend du régime de change. Comme l'a mentionné Ball et al. (2008), le type de régime de change peut influencer la relation entre les transferts et le taux de change réel car les transferts étant envoyés en monnaie étrangère doivent être convertis (au moins en

partie) en monnaie domestique pour être dépenser. Ainsi, une augmentation des transferts conduit à une augmentation de la demande de monnaie domestique. L'effet d'une augmentation de la demande de monnaie dépend du régime de change. En changes flexibles, une augmentation de la demande de monnaie, en appréciant la monnaie domestique, entraine une augmentation du taux d'intérêt domestique, via la parité du taux d'intérêt. Par contre, en changes fixes, une augmentation de la demande de monnaie, en augmentant les réserves de changes, conduit à une augmentation de l'offre de monnaie domestique. Par conséquent, une augmentation des transferts, en augmentant la demande de monnaie, conduit à une appréciation du taux de change dont l'ampleur dépend du régime de change.

L'objectif du chapitre 4 est d'examiner l'effet des transferts des migrants sur le taux de change réel, en utilisant des données de panel sur les pays de la zone Franc CFA. Comme la zone Franc CFA est en union monétaire, l'échantillon des pays de cette zone n'est pas sujet à la critique de l'interférence du régime de change sur la relation entre le taux de change réel et les transferts. Le chapitre 4 examine aussi les effets des autres flux de transferts (aide publique étrangère, investissements directs étrangers) sur le taux réel des pays de la zone Franc CFA, et en comparant ces effets à celui des transferts des migrants. Contrairement aux transferts des migrants, l'aide étrangère n'est pas forcément destinée à la consommation, et les investissements directs étrangers sont destinés à des projets d'investissement.

Modèle théorique

Avant l'étude empirique, le chapitre 4 expose un modèle théorique monétaire à petite économie ouverte pour montrer que l'effet des transferts des migrants sur le taux de change

réel dépend du régime de change. Contrairement au modèle du chapitre 3, le modèle de ce chapitre est non stochastique. Dans ce modèle, la fonction d'utilité de l'agent représentatif dépend de la consommation du bien échangeable et du bien non échangeable, et, de l'encaisse monétaire détenue. Le ménage représentatif peut détenir des actifs étrangers. Il perçoit les revenus issus de la vente des biens produits localement (biens échangeables et non échangeable) et des transferts forfaitaires, et il reçoit aussi des transferts des migrants travaillant à l'étranger.

La technologie de production dans les secteurs (secteur des biens échangeables et secteur des biens non échangeables) utilise uniquement la force de travail. Le travail est supposé parfaitement mobile entre les deux secteurs, et la dotation en force de travail est fixée à l'unité. La loi du prix unique est supposée être vérifiée pour les biens échangeables. Les prix dans le secteur des biens non échangeables sont supposés être rigides et leur fixation se fait à la Calvo (1983).

Les résultats du modèle théorique montrent qu'une augmentation des transferts conduit à une appréciation du taux de change à long terme dont l'ampleur est la même quel que soit le régime de change. Par contre, à court terme, l'effet d'une augmentation des transferts sur le taux de change dépend du régime de change. Dans un régime de changes fixes, comme le cas de la zone CFA, l'effet d'une augmentation des transferts conduit à une augmentation de la croissance de la masse monétaire, une augmentation de l'inflation et une appréciation du taux de change réel. Par contre, en régime de changes flexibles, une augmentation des transferts conduit à court terme à une baisse de l'inflation et à une appréciation du taux de change réel (la croissance de l'offre de monnaie étant fixe par hypothèse), cette appréciation du taux de change réel étant plus élevée qu'en change fixe.

Ces résultats s'expliquent par les mécanismes suivants. En change fixe, une augmentation des transferts des migrants conduit à une augmentation de la demande d'encaisse réelle. Pour maintenir constant le taux de change, la banque centrale réagit en augmentant l'offre de monnaie nominale, afin de compenser l'augmentation de la demande de monnaie. Cette augmentation de l'offre de monnaie entraine une hausse immédiate des prix des biens non échangeables, car les prix des biens échangeables suivent la loi du prix unique. L'augmentation des prix des biens non échangeables correspond à une appréciation du taux de changé réel. Dans la dynamique transitoire, les prix et le taux de change réel s'apprécient continuellement vers le nouvel état stationnaire.

En changes flexibles, à la suite de l'augmentation de la demande d'encaisse réelle provoquée par les transferts, l'offre de monnaie étant fixe (par hypothèse en changes flexibles), le taux de change nominal s'apprécie et les prix des biens non échangeables sont poussés à la baisse. Par conséquent, le taux de change réel s'apprécie avec une ampleur plus élevée qu'en change fixe. Durant la dynamique transitoire, le taux de change réel rejoint le nouvel état stationnaire dont l'appréciation est plus faible qu'à la première période de réaction. Etant donné que dans les deux régimes de change, le taux d'inflation du nouvel état stationnaire est identique à celui de l'état stationnaire initial, l'appréciation du taux de change réel de long terme sera le même dans les deux régimes.

L'aide publique étrangère est aussi introduite dans le modèle théorique, pour comparer les effets (sur le taux de change réel) des transferts des migrants à ceux de l'aide publique. Il est à noter que l'aide étrangère est composée des dons et des prêts. Les dons sont vus comme des ressources gratuites (comme les transferts des migrants) et peuvent se substituer au revenu domestique. Par contre, les prêts sont remboursés dans le futur avec

leurs intérêts. Cependant, une grande part des prêts est sous forme concessionnelle et les dettes liées aux prêts sont fréquemment annulées. Ainsi, les décideurs politiques dans les pays en développement ont tendance à ne pas faire la différence entre les dons et les prêts. Pour cette raison, dans ce chapitre, uniquement l'effet des dons est examiné et l'aide publique étrangère est assimilée aux dons.

Contrairement aux transferts des migrants, les dons sont reçus par le gouvernement et ce dernier peut décider de transférer les dons aux ménages ou de financer la provision du bien publique. Ce bien public peut être une composition des biens échangeables et non échangeables. Ainsi, la demande émanant du gouvernement peut être adressée au secteur du bien échangeable et au secteur du bien non échangeable. Le bien public peut être non productif ou productif.

Les résultats montrent que si les dons sont totalement transférés aux ménages, les dons auront les mêmes effets que les transferts des migrants. Par contre, si les dons sont utilisés pour financer la provision en bien public, l'effet des dons sur le taux de change réel dévient ambigu. Supposons tout d'abord que le bien public est improductif. Si la provision du bien public se fait en bien échangeable, une augmentation des dons finançant la fourniture du bien public n'a aucun effet sur le taux de changé réel. En effet, dans cette configuration, les importations augmentent dans la même proportion que les dons. Si la provision du bien public se fait en biens non échangeables, une augmentation des dons finançant la fourniture du bien public conduit à une appréciation du taux de change réel. En effet, dans ce cas, l'augmentation des dons provoque un excès de demande de biens non échangeables, donc une augmentation du prix relatif des biens non échangeables (i.e., une appréciation du taux de change réel).

Si le bien public est productif, l'effet des dons sur le taux de change réel dépendra de l'augmentation de la productivité dans les deux secteurs. Si le bien public augmente la productivité dans le secteur des biens non échangeables, l'augmentation des dons aura un effet ambigu sur le taux de change, même si la fourniture du bien public se fait en bien non échangeable.

Données et résultats empiriques

Le chapitre 4 termine avec l'estimation empirique pour tester les prédictions du modèle théorique sur les pays de la zone Franc CFA. La zone Franc CFA étant en union monétaire et en change fixe ancré sur l'euro (le Franc français avant 2002), l'effet des transferts des migrants sur le taux de change doit être homogène sur les pays de la zone Franc CFA. Par conséquent, l'estimation en panel sur ces pays est appropriée. L'étude empirique porte sur 10 pays de la zone Franc CFA (sur un total de 14 pays) choisis en fonction de la disponibilité des données. Les données sont annuelles et couvrent la période 1980-2007.

Le modèle à estimer est un modèle en panel dynamique pour tenir compte de la persistance dans le taux de change réel. La technique économétrique utilisée est la méthode des moments généralisée en système à la Arrenalo et Bond (GMM en système). Pour éliminer l'effet fixe, cette technique combine l'équation en différence et en niveau ; et elle utilise les retards des variables endogènes pour instrumenter l'équation en différence et les retards des variables endogènes différenciées pour instrumenter l'équation en niveau.

Les variables explicatives incluses dans le modèle sont : les transferts des migrants (en pourcentage du PIB), les dons publics étrangers (en pourcentage du PIB) et les prêts publics étrangers (en pourcentage du PIB), les fonds directs étrangers, le PIB par tête, les

dépenses gouvernementales (en pourcentage du PIB), le terme d'échange, le degré d'ouverture commerciale (somme des importations et des exportations en pourcentage du PIB), et une variable dummy qui prend la valeur 1 en 1994 (date de la dévaluation du Franc CFA) et 0 ailleurs.

Comme mentionné ci-dessus, on s'attend à ce que les transferts des migrants apprécient le taux de change réel. Par contre, on s'attend à un effet ambigu de l'aide publique étrangère (dons et prêts). On s'attend à ce que les fonds directs étrangers apprécient le taux de change réel. Cependant, les fonds directs étrangers sont associés à des investissements productifs, donc l'appréciation éventuelle du taux de change réel par les fonds directs étrangers doit être plus faible que celle des transferts des migrants. Le PIB par tête est utilisé pour tenir compte de l'effet Balassa-Samuelson selon lequel une augmentation du progrès technique conduit à une appréciation du taux de change réel. Les dépenses gouvernementales entraineront une appréciation du taux de change réel, si les biens non échangeables sont plus importants dans la composition du bien public que les biens échangeables. Une détérioration des termes d'échange entrainera une dépréciation du taux de change réel, si l'effet de substitution (baisse de la demande de biens non échangeables) prédomine l'effet revenu. Par contre, une augmentation du degré d'ouverture conduira à une dépréciation du taux de change réel, si l'effet de substitution prédomine. La dévaluation du Franc CFA en 1994 est censée conduire à une dépréciation du taux de change réel.

Les résultats empiriques montrent que, contrairement aux autres flux de capital (aide publique étrangère et fonds directs étrangers), une augmentation des transferts des migrants conduit à une appréciation du taux de change réel dans les pays de la zone Franc CFA. La non significativité l'aide publique étrangère (qu'elle soit dons et prêts) et des fonds directs

étrangers peut être expliquée par les raisons invoquées ci-dessus. En d'autres termes, les résultats suggèrent que, contrairement aux autres flux de capital, les transferts des migrants reçus dans les pays de la zone Franc CFA sont dirigés vers la consommation. Les résultats montrent aussi que la dévaluation de 1994 a entrainé une dépréciation du taux de change réel. Les dépenses publiques, les termes d'échange et le degré d'ouverture ne sont pas significatifs, ce qui peut être expliqué par les raisons mentionnées ci-dessus. On a aussi un effet non significatif du PIB par tête. La raison de cette non significativité (non vérification de l'effet Balassa-Samuelson) est peut être dû au fait que la productivité globale est dirigée par le secteur industriel qui est moins important dans les pays de la zone Franc CFA.

Transferts des migrants, développement financier et volatilité macroéconomique

Motivation

Comme il a été démontré que la volatilité de la croissance économique conduit à des effets néfastes (baisse de la croissance de long terme, baisse du bien être, augmentation de la pauvreté), les économistes ont cherché les facteurs expliquant la volatilité macroéconomique. Ainsi, Chami et al. (2008) ont examiné si les transferts des migrants affectent la volatilité de la croissance. Ils ont souligné plusieurs canaux par lesquels les transferts des migrants affectent la volatilité macroéconomiques. Ces canaux conduisent à des effets contradictoires.

Les transferts des migrants permettent aux ménages receveurs de lisser leurs consommations et leurs investissements. Dans ce cas, si le montant des transferts est élevé, ils

aideront à réduire la volatilité économique dans le pays receveur. D'autre part, dans la mesure où les transferts des migrants peuvent passer par le système financier, ils peuvent faciliter l'accès au crédit et permettent ainsi aux firmes de lisser leurs investissements.

Cependant, les transferts peuvent augmenter la volatilité macroéconomique en changeant le comportement des ménages receveurs. Les transferts, s'ils sont altruistes, en rendant procyclique l'offre de travail des ménages receveurs, peuvent augmenter la fluctuation macroéconomique. En effet, en présence des transferts altruistes, beaucoup de transferts sont effectués en cas de chocs négatifs, poussant ainsi les ménages receveurs à baisser leurs offres de travail. En outre, les ménages receveurs des transferts peuvent choisir des projets risqués ou fournissent moins d'effort pour vérifier la qualité des projets. Ce qui peut conduire à une dispersion des rendements des projets d'investissement et ainsi à une augmentation de la volatilité de la production.

En utilisant des données en coupe transversale sur 70 pays (16 pays développés et 54 pays en développement), Chami et al. (2008) ont trouvé que les transferts des migrants réduisent la volatilité de la croissance. Bugamelli and Paternò (2009a), en utilisant des données en coupe transversale sur 60 pays émergents et en développement, ont aussi trouvé que les transferts réduisent la volatilité.

Le chapitre 5 contribue à cette littérature sur la relation entre les transferts des migrants et la volatilité macroéconomique. Contrairement à Chami et al. (2008) et Bugamelli and Paternò (2009a), le chapitre 5 examine empiriquement la relation entre les transferts et la volatilité de la croissance, en regardant particulièrement l'interaction entre les transferts et le développement financier. Plus précisément, le chapitre 5 analyse comment un système financier bien développé peut influencer la relation entre les transferts des migrants et la

volatilité macroéconomique. En effet, comme mentionné ci-dessus, d'une part, les transferts peuvent réduire la volatilité en permettant aux individus receveurs de lisser leurs consommation (et l'investissement). D'autre part, les transferts peuvent augmenter la volatilité en incitant les individus receveurs à investir dans des investissements plus risqués sans vérifier la qualité de leurs rendements. Un système financier bien développé, en donnant de l'information sur la qualité des projets d'investissement, peut diriger les transferts vers des investissements moins risqués. Par conséquent, il peut permettre aux transferts des migrants d'être moins déstabilisateurs ou d'être plus stabilisateurs.

Contrairement à Chami et al. (2008) et Bugamelli and Paternò (2009a), l'étude empirique dans ce chapitre 5 est faite en utilisant une approche en panel. L'approche en panel permet aux variables de changer au cours du temps.

Données et résultats empiriques

Pour produire des données en panel, la volatilité de la croissance (variable dépendante) est calculée par l'écart type en glissement de la croissance annuelle du PIB par tête sur des intervalles de cinq ans. Pour tenir compte de la taille des économies, les transferts des migrants sont exprimés en pourcentage du PIB et sont calculés par leur moyenne en glissement sur des intervalles de cinq ans. Comme dans les parties précédentes, les données sur les transferts des migrants sont issues de la base de données des indicateurs de développement (World Development Indicator - WDI) de la Banque Mondiale. Les variables de contrôle sont : l'indice du développement financier, la volatilité du changement des termes d'échanges, la volatilité de l'inflation, le PIB par tête, la population, et l'indice du degré d'ouverture. Ces variables de contrôle sont aussi issues de WDI.

L'indice du développement financier est considéré comme une des variables déterminantes de la volatilité macroéconomique. Plus le secteur financier est développé, plus les agents ont accès au crédit pour lisser leurs investissement. Comme dans Beck et al. (2006), l'indice du développement financier est mesuré par les crédits octroyés au secteur privé par les banques (en pourcentage du PIB). Pour produire des données de panel sur cette variable, sa moyenne en glissement est calculée sur des périodes de cinq ans.

Comme dans Beck et al. (2006), la volatilité de la variation des termes d'échange et la volatilité de l'inflation sont utilisées respectivement pour capturer l'exposition de l'économie aux chocs réels et monétaires. Ces variables sont calculées par leur écart type en glissement sur des périodes de cinq ans.

Le PIB réel par tête est utilisé pour capturer le fait que, plus le pays est riche, plus le pays dévient stable (Easterly et al., 2000). Cette variable est aussi calculée par sa moyenne en glissement sur des intervalles de cinq ans (et prise en log). La population est utilisée pour tenir compte du fait que, plus le pays est grand, plus il a une grande capacité de diversifier ses ressources (Mobarak, 2005). La population (en log) du début de la période des intervalles de cinq ans est utilisée dans la régression.

Pour faire des estimations en variables instrumentales, comme dans Aggarwal et al. (2006), les instruments utilisés sont : le PIB par tête et le taux de chômage des pays d'accueil des migrants (pays de provenance des transferts). Ces variables servent à capturer les conditions économiques dans les pays d'accueil des migrants et reflètent la capacité et le désir du pays d'accueil de recevoir la main d'oeuvre étrangère. Le PIB par tête (ou le taux de chômage) du pays de provenance des transferts est calculé par une moyenne pondérée du PIB par tête (taux de chômage) des cinq pays de l'OCDE qui sont les premières destinations

des émigrants du pays considéré. La pondération de chacun des cinq pays est donnée par la part des migrants reçus dans le total des émigrants du pays considéré. Les données sur le PIB par tête et le taux de chômage des pays de l'OCDE sont issues de WDI. Les données sur l'immigration sont issues de la base de données des migrants et des expatriés de l'OCDE (database on immigrants and expatriates).

Pour examiner si l'effet des transferts des migrants sur la volatilité dépend du développement financier, le modèle est estimé sur des sous-échantillons : en-dessous et au-dessus de la médiane de l'indice du développement financier, en-dessous du percentile 80 de l'indice du développement financier et au-dessus du percentile 20 de l'indice du développement financier.

Les résultats montrent que l'effet des transferts sur la volatilité macroéconomique dépend du développement financier. Plus précisément, les résultats montrent que les transferts des migrants réduisent plus la volatilité dans un environnement où le développement financier est très élevé.

Pour tenir compte de la causalité entre les transferts des migrants et la volatilité de la croissance, le modèle a été estimé par la méthode des variables instrumentales. Pour les motifs d'altruisme ou d'égoïsme, les transferts peuvent réagir aux conditions économiques (stabilité macroéconomique) dans le pays receveur des transferts. Comme mentionné ci-dessus, les instruments utilisés sont le PIB par tête et le taux de chômage dans les pays d'accueil des migrants. Les résultats issus des estimations des variables instrumentales montrent aussi que les transferts sont plus stabilisateurs dans un environnement où le système financier est bien développé.

Pour tester la robustesse des résultats, la technique d'estimation du modèle PSTR (Pa-

nel Smooth Transition Regression) est employée. Cette nouvelle technique d'estimation développée par Gonzàlez et al. (2005) permet d'estimer le modèle en permettant l'effet des transferts des migrants sur la volatilité de changer de manière lisse entre différents régimes, en fonction du niveau du développement financier. Les résultats de cette technique d'estimation confirment que l'effet des transferts des migrants sur la volatilité dépend du degré du développement financier. Plus précisément, l'effet des transferts sur la volatilité varie de manière lisse entre deux régimes. Dans le premier régime où le développement financier est très faible les transferts des migrants ont tendance à augmenter la volatilité. Dans le second régime où le développement financier est très élevé, les transferts des migrants réduisent la volatilité macroéconomique.

Conclusion

Cette thèse apporte quatre contributions à la littérature sur les transferts internationaux des migrants, en adoptant une approche macroéconomique. La première contribution (Chapitre 2) est sur les déterminants macroéconomiques des transferts. Plus précisément, le chapitre 2 examine empiriquement la réaction des transferts des migrants aux conditions économiques dans le pays d'accueil et dans le pays d'origine des migrants. Cette étude empirique est élaborée en employant une approche de panel VAR permettant de bénéficier de l'avantage de l'approche VAR et des techniques de panel. Les données utilisées sont annuelles de 1990 à 2008 et sont issues de 14 pays d'Amérique Latine et Caraïbes (le Belize, la Bolivie, la Colombie, la République Dominicaine, l'Equateur, l'El Salvador, le Guatemala, le Guyana, l'Haïti, le Honduras, la Jamaïque, le Mexique, le Nicaragua, et le Pérou). Ces 14 pays ont été sélectionnés dans le but de faciliter le choix du pays d'accueil des migrants. Les

États-Unis d'Amérique sont le seul pays d'accueil considéré, car la plus part des migrants provenant de ces 14 pays vont aux Etats-Unis. Les résultats de cette première contribution de la thèse montrent que les transferts des migrants répondent plus aux conditions macroéconomiques dans le pays d'accueil des migrants qu'aux conditions macroéconomiques dans le pays d'origine des migrants. Environ 33% de la fluctuation des transferts des migrants est expliquée par les conditions macroéconomiques du pays d'accueil, alors que les conditions macroéconomiques du pays d'origine n'ont pas de part signifiante dans la fluctuation des transferts des migrants.

Les trois autres contributions sont sur les impacts macroéconomiques des transferts des migrants. La deuxième contribution de cette thèse (Chapitre 3) contribue à la littérature des sources de fluctuations en examinant le rôle des chocs des transferts des migrants dans les fluctuations macroéconomiques des pays en développement. Un modèle DSGE calibré sur l'économie du Sénégal est utilisé pour évaluer quantitativement le rôle des chocs des transferts des migrants dans la fluctuation macroéconomique. Ce modèle DSGE est composé de trois biens (biens non échangeables, biens exportables et biens importables). Les autres chocs considérés sont : chocs des termes d'échanges, chocs de taux d'intérêt mondial et les deux chocs de productivité domestique (biens non échangeables et biens exportables). Les résultats de cette deuxième contribution de la thèse montrent que les chocs des transferts des migrants expliquent environ 10% de la fluctuation du PIB du Sénégal. Environ 20% de la fluctuation du taux de change réel du Sénégal est expliquée par les chocs des transferts des migrants.

La troisième contribution de cette thèse (Chapitre 4) analyse l'effet des transferts des migrants sur le taux de change réel, en utilisant des données de panel sur les pays de la zone

Franc CFA. Avant l'étude empirique, le chapitre 4 expose un modèle théorique monétaire à petite économie ouverte pour mettre en évidence que l'effet des transferts des migrants sur le taux de change réel dépend du régime de change. Contrairement au chapitre 3, le chapitre 4 examine l'effet du niveau des transferts des migrants sur le taux de change réel dans un cadre monétaire non stochastique. Le modèle utilisé est un modèle monétaire à petite économie ouverte composée de deux secteurs (secteurs des biens échangeables et secteur des biens non échangeables). Les résultats du modèle théorique montrent qu'une augmentation des transferts conduit à une appréciation du taux de change réel de long terme dont l'ampleur est la même quel que soit le régime de change. Par contre, à court terme, l'effet d'une augmentation des transferts sur le taux de change réel dépend du régime de change. A court terme, l'augmentation des transferts des migrants conduit à une appréciation du taux de change réel plus prononcée en changes flexibles qu'en changes fixes. L'étude empirique dans le chapitre 4 est élaborée en utilisant la méthode des moments généralisée en système à la Arrenalo et Bond (GMM en système). Les données utilisées sont annuelles (de 1980 à 2007) et sont issues de 10 pays de la zone Franc CFA (choisis en fonction de la disponibilité des données sur un total de 14 pays). Les résultats empiriques montrent que, contrairement aux autres flux de capital (aide publique étrangère et fonds directs étrangers), les transferts des migrants conduisent à une appréciation du taux de change réel dans les pays de la zone Franc CFA.

Contrairement aux deuxième et troisième contributions, la quatrième (dernière) contribution de cette thèse (Chapitre 5) est sur un aspect positif des transferts des migrants. Le chapitre 5 examine empiriquement la relation entre les transferts et la volatilité de la croissance, en regardant particulièrement l'interaction entre les transferts et le développe-

ment financier. Plus précisément, le chapitre 5 analyse comment un système financier bien développé peut influencer la relation entre les transferts des migrants et la volatilité de la croissance. Cette étude empirique est effectuée en utilisant des données (annuelles) de panel sur 75 pays en développement de 1980 à 2008. Plusieurs méthodologies économétriques ont été employées : moindres généralisés faisables (pour tenir compte de l'hétéroscédasticité des données de panel), variables instrumentales (pour tenir compte de l'endogenéité des transferts des migrants) et modèle de changement de régime en panel (pour permettre à l'effet des transferts sur la volatilité de la croissance de dépendre du développement financier). Les résultats empiriques montrent que les transferts des migrants réduisent la volatilité de la croissance ; cette réduction étant plus prononcée dans un environnement où le développement financier est très élevé.

Chapitre 1

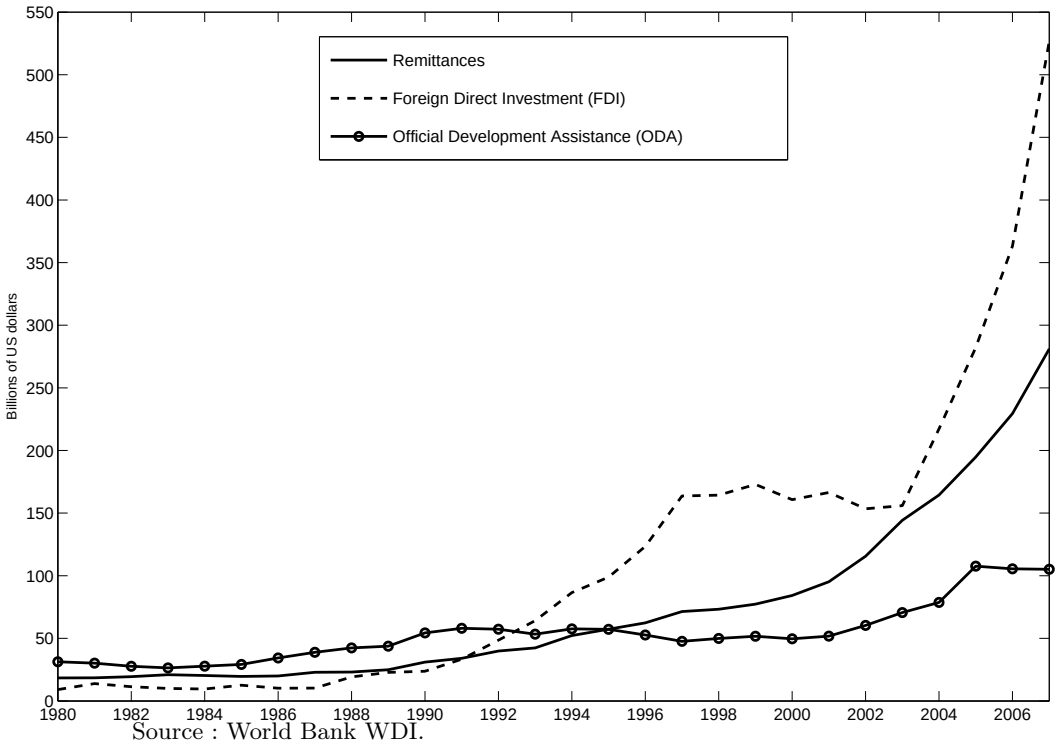
General introduction : An overview of the existing literature on remittances

1.1. Introduction

The recent years were marked by the increasing role of emigrants remittances in total international capital flows. In the aggregate, remittances are currently the second largest source of foreign exchange after foreign direct investment (Figure 1.1). For many developing countries, remittances represent a significant part of income (Figure 1.2).

Since remittances affect the lives of many people around the world, researchers have examined the determinants of remittances in both theoretical and empirical frameworks. At the same time, researchers have analyzed the development impact of remittances. This introductory chapter reviews the existing literature on the theoretical and empirical deter-

FIGURE 1.1 – Remittances, Foreign Direct investment and Official Development Assistance received in Developing countries.



Source : World Bank WDI.

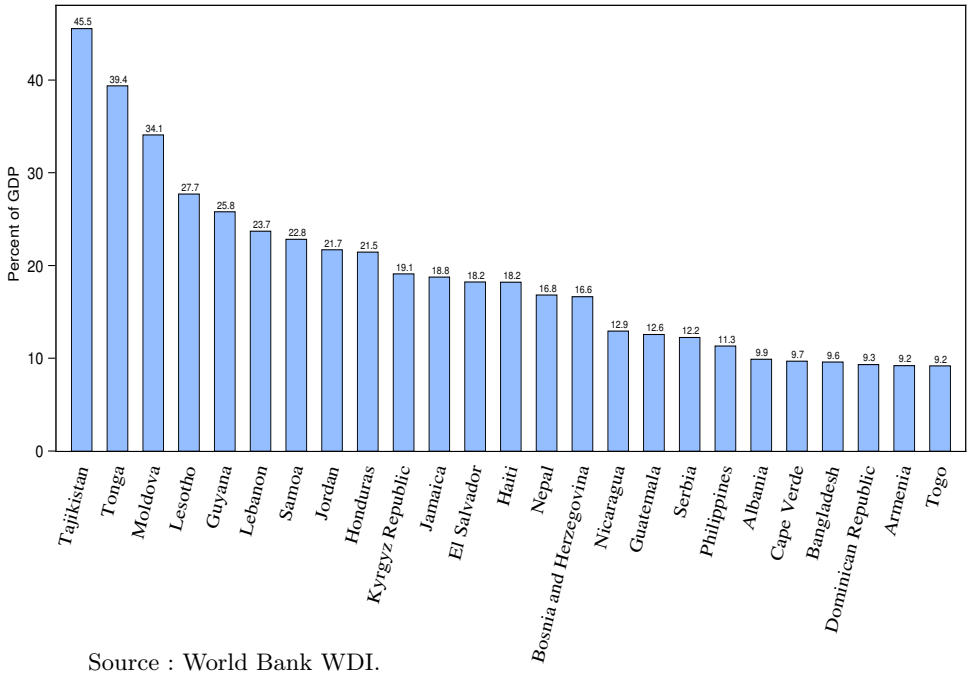
minants of remittances and discusses the development impact of remittances.

The rest of this introductory chapter is organized as follows. Section 2 provides an overview of the theoretical determinants of remittances. Section 3 presents the empirical determinants of remittances in microeconomic and macroeconomic frameworks. Section 4 discusses the impacts of remittances on developing economies. Section 5 concludes with a summary of findings from the existing literature and exposes the outline of the thesis.

1.2. Theoretical determinants of remittances

With the pioneer paper "Motivations to remit : Evidence from Botswana", Lucas and Stark (1985) initiated the theoretical debate about the determinants of remittances. Lucas

FIGURE 1.2 – Top remittances-recipient in 2008 (remittances as percent of GDP)



Source : World Bank WDI.

and Stark (1985) considered the phenomenon of international remittances in the framework of the new economics of labor migration (NELM), based on contract theory. In such framework, the decision to migrate and to remit is part of the overall household decision making process, and the remitter's utility includes consumption of the remaining household members in the home country. Then, Lucas and Stark (1985) point out that the main motives to remit are "pure altruism", "pure self-interest" and "tempered altruism or enlightened self-interest". The latter category can include any kind of contractual arrangements between the migrant and her family (such as co-insurance, exchange-motives, loan repayment).

1.2.1. Pure altruism remittances

One can naturally admit that remittances are sent to home due to the altruistic behavior of migrant. The altruistic model was first developed by Lucas and Stark (1985). In this framework, the migrant cares about the economic situation of his or her family left behind at home. Hence, there is a positive link between remittances and adverse shocks on recipient's income. Precisely, remittances would increase with the migrant's income in host country, but decrease with the family's income at home. In other words, emigrants with higher earnings potentially remit more, and emigrant send more money if the economic situations of the family worsen. Funkhouser (1995) points out other testable implications in the context of altruistic motives. This author argues that remittances are positively related to both the degree of proximity between the migrant and the remaining household members and the migrant's intentions to return. Moreover, Funkhouser (1995) also argues that remittances should decrease with the number of other emigrants from the same household.

1.2.2. Pure self-interest remittances

Remittances can also be driven by self-interest motives. In this context, Lucas and Stark (1985) indicate that there are three reasons to remit relying on purely selfish motivations and the absence of altruism by the migrant toward the family.

The first reason is the aspiration to inherit. In this case, as mentioned by Lucas and Stark (1985), if inheritance is conditioned on behavior, the migrant's motive for supporting his or her parents may encompass the concern to get inheritance. In this case, remittances should increase with the potential inheritance.

A second reason of self-interest remittances is to invest in assets in home country. In this context, remittances behave as any other international capital inflow, driven by selfish motives. In this case, remittances would reflect the migrant's desire to invest in the country of origin, and domestic households could be viewed as intermediaries who invest remittances according to the desire of the migrant (Acosta et al., 2009). Then, the migrant will send more remittances to exploit investment opportunities, if the economic conditions of home country improve.

The third reason to remit in the self-interest context is the intent to return to home. In this case, as argued by Lucas and Stark (1985), the migrant sends money to investment in fixed capital (such as land, livestock or house) or in public assets, in order to obtain prestige or political influence. Therefore, remittances would increase with the migrant income in host country.

Pure altruism and pure self-interest are not sufficient to explain the extent of remittance. Remittances can also be viewed as contractual arrangement between the migrant and her family. Nevertheless, altruism and self-interest motives can play a role in the contractual arrangements, by making the contract self-enforcing (Rapoport and Docquier, 2005). The contractual arrangements can be co-insurance, loan repayment and exchange for services.

1.2.3. Co-insurance motive

The theoretical model of co-insurance motive was also first developed by Lucas and Stark (1985). Due to market imperfections in the home country (for example, a bad social protection system), a household member migrates under co-insurance agreement with the other family members. Then, the household member who migrates would insure the

remaining members of family against shocks. When necessary, the family also supports the migrant in case of unemployment or retirement. In this case, migration occurs where income at origin is more volatile, and remittances should be irregularly sent (Rapoport and Docquier, 2005). To be operating, however, the co-insurance agreement needs to be self-enforcing. As mentioned by Rapoport and Docquier (2005), this is generally the case because a sufficient degree of altruism exists within the family, or, because family has reliable information on members.

1.2.4. Family loan arrangements : the investment motive

A family loan arrangement or investment motive is another type of contractual agreement. Cox and Rank (1992) was the first to provide a theoretical framework for the investment motive. As noticed by Rapoport and Docquier (2005), the pioneer paper of Lucas and Stark (1985) refer to the investment motive by just giving outlines for the underlying theory. In the investment motive context, remittances can be viewed as the repayments of a loan on investment in education and/or migration. At the first period, the household finances the education of the potential migrant. Thanks to the education acquired, the migrant would able to find a better-paid job abroad, and then, would be able to send remittances to reimburse the household for the initial investment. Besides, the migrants will also become a lender, by financing other family members. In such contractual agreement, there should be a positive relationship between remittances and migrant's education level. However, as pointed out by Lucas and Stark (1985), the fact that more educated migrants tend to remit more is not an evidence that remittances are a repayment of investment by the family in the migrant's education. Lucas and Stark (1985) thus argue that the invest-

ment hypothesis implies that repayments by his or her own children should be higher than that by other members (sons or daughters in law), for a given education level.

1.2.5. Exchange motive

A final contractual agreement is the exchange motive that was first developed by Cox (1987). In this framework, migrant send remittances in order to buy different kinds of services provided by remittances recipients such as taking care of the migrant's assets (e.g., land, cattle) or relatives (children, elderly parents) at home. As pointed out by Rapoport and Docquier (2005), such motivations are generally the sign of a temporary migration, and signal the migrants' intention to return. Another intuitive way intentioned by Rapoport and Docquier (2005) is to think that, due to market imperfections, transaction costs may be reduced by non-market interpersonal agreements.

The prediction of the exchange model is in contrasts with that of the altruistic model : an increase in the recipient's income may induce a rise in the amount to remit. If the recipient's income increases, recipient would have the power to claim more compensation (transfer) of services providing. In this case, the migrant will send more or less remittances depending on the migrant's elasticity of service demand. Therefore, if migrant's demand for the services is elastic, an increase in recipient's income would cause a decrease in remittances. On the contrary, if migrant's demand for the services is inelastic, a rise in recipient's income would induce more remittances.

1.2.6. Strategic motive

The strategic model was first developed by Stark (1995) (Chapter 4). In this model, the strategic behavior to remit is based on the wage differentials which depends on productivity differentials. The idea is that, since migrants are heterogeneous in skills and individual productivity is not perfectly observable on the labor market of the host country, employers will pay to migrant workers the average productivity of their minority group. In this case, high skilled migrants have high benefice by migrating, and they are the first to migrate. The high skilled may have an incentive to send more remittances to home in order to keep unskilled workers in their home country and, thus, to avoid the depression of skilled migrant's wage by unskilled migration (Rapoport and Docquier, 2005).

The prediction of the strategic model is that remittances will increase with income and education of migrant and will decrease with income at origin. This makes difficult to distinguish the strategic model from the altruistic model.

In order to check whether a given prediction is distinctive of a particular theory, Table 1.1 (inspired by Rapoport and Docquier (2005)) summarizes the testable hypothesis of the six motives for remittances. The table reports the sign of the impact of potential explanatory variables on remittances received. The mention "nde" (no direct effect) indicates that the impact of the corresponding variable is expected to be insignificant, at least if other controls are included.

TABLE 1.1 – Theoretical determinants of remittances

Expl. Variables	Pure altruism	Pure self-interest	Co-insurance	Loan repayment	Exchange motives	Strategic motives
Migrant's income	+	+	nde	+	+	+
Migrant's education	nde	nde	nde	+	+	+
Recipient's income	-	+	nde	+/-	+/-	-
Shocks on recipient's income	+	nde	+	nde	nde	+
Shocks on migrant income	nde	nde	+	nde	nde	nde
Intent to return	+	+	nde	nde	nde	nde
Number of emigrants	-	nde	nde	nde	nde	nde
Distance from family	+	-	nde	nde	nde	-
Time since arrival	-	nde	nde	nde	nde	-

Note : nde= "no direct effect" after controlling for migrants' and/or recipients' incomes. Table inspired by Rapoport and Docquier (2005).

1.3. Empirical determinants of remittances

Researchers have tried to test the predictions of the theoretical model on remittances motives discussed in the previous section. This section presents the literature on both the microeconomic and macroeconomic determinants of remittances, both from receiving and sending perspectives.

1.3.1. Empirical determinants of remittances in microeconomic context

This subsection discusses the literature on the microeconomic determinants of remittances. The existing empirical papers on the determinants of remittances have used very different econometric methodologies.

The first empirical study to examine the microeconomic determinants of remittances is the leading work of Lucas and Stark (1985) on Botswana. In this pioneering study, Lucas

and Stark (1985) used Ordinary Least Square (OLS) techniques and found that remittances increase with the migrants' earnings, which is consistent with a variety of motives explained above, including altruism. However, pure altruism implies that remittances are primarily directed to households with low-incomes, while Lucas and Stark (1985) find a positive association between amount remitted and per capita income of the household. Therefore, their results show evidence that exchange, investment and inheritance motives are relevant in explaining remittances behavior.

The pioneering work by Lucas and Stark (1985) has lead to further studies about the empirical microeconomic determinants of remittances. Some works have also found a positive relationship between remittances and recipient's incomes, particularly Cox (1987), Cox and Rank (1992), Cox et al. (1998). Cox (1987) estimated a probit model on data from President's Commission on Pension Policy (PCPP) survey and found that transfer amounts increase with recipient income, which contradicts a key prediction of the pure altruism hypothesis but it is in line with exchange hypothesis. Using probit techniques on data from National Survey of Families and Households, Cox and Rank (1992) found results that are more consistent with exchange hypothesis than altruism hypothesis. Cox et al. (1998) estimated a probit model on data from household survey for Peru and found the same result.

The loan repayment motives (or investment motives) was supported by the work of Ilahi and Jafarey (1999). Ilahi and Jafarey (1999) estimated a probit model on data from household survey for Pakistan and found that remittances to the immediate family and savings retained abroad decrease with the pre-migration loan.

The inheritance hypothesis was also supported by the study of Hoddinott (1994). Hoddi-

nott (1994) used data from western Kenya to estimate a remittance function after controlling for two sources of selection bias. The first source of selection bias is the fact that migrants are a non-random group, while the second source is the fact that remittances behavior depends on the parent's information about migrant's earning abroad. The author found that remittances increase with parental ownership of an inheritable asset.

The insurance hypothesis was supported by Gubert (2002). Gubert (2002) employed Powell's Censored Least Absolute Deviation (CLAD) estimators in addition to parametric estimators on survey data from the Kayes area (Western Mali). The author found results showing that insurance plays a key role in the motivation to remit. However, employing the Heckman procedure and maximum likelihood estimation on data from Guyana, Agarwal and Horowitz (2002) found a negative effect of the number of migrants on remittances received. Based on the argument of multiple-migrant households, they interpreted this findings as supporting altruism hypothesis.

Using data on rural region of Dominican Republic, de la Briére et al. (2002) examine whether remittances to poor rural region are better explained by insurance motives or inheritance motives (two motives that are very close). The authors employ four alternative estimations procedures : OLS, random-effect model (clustered by household), standard Tobit, and a censored remittances. The results suggest that the relative relevance of each motive depends on many factors : the migrant's destination (the U.S. or Dominican cities), the migrant's gender, and the composition of the receiving household. The results also show that the insurance hypothesis holds for female migrants to the US. In contrast, the insurance hypothesis holds for males only when a male is the sole migrant in his household. On the other hand, investment in inheritance is pursued by both males and females, but

only among those migrating to the US.

This discussion above shows evidence that the contractual arrangement are most involved in explaining remittances behavior. Therefore, Rapoport and Docquier (2005) conclude that : "*On the whole, the evidence from micro surveys confirms that patterns of remittances are better explained as familial inter-temporal contracts than as a result of altruism or other purely individualistic considerations.*" As noticed by Rapoport and Docquier (2005), this is not to deny the importance of individualistic motives.

1.3.2. Empirical determinants of remittances in macroeconomic context

The literature on the macroeconomic determinants of remittances is relatively less developed. Some empirical papers have examined the macroeconomic determinants of remittances both from receiving and sending perspectives.

In order to capture host economic conditions, host country GDP (income) is generally used as explanatory variable, since this variable impacts the migrant's consumption and savings. Elbadawi and Rocha (1992), El-Sakka and McNabb (1999) and Lianos (1997) found a significant positive effect of host income on remittances. Some studies also used host unemployment rate to capture host economic conditions. Higgins et al. (2004) found a significant positive effect of host unemployment rate on remittances, while Lianos (1997) found an inconclusive effect of host unemployment rate on remittances.

To capture economic activity in home country (altruistic motivation), per capita GDP in home country is generally considered (El-Sakka and McNabb, 1999 ; Lianos, 1997). Here, the intuition is that, for altruistic motivation, the more depressed income is in the home country, the more remittances increase. In contrast, for self-interested motives, remittances

will positively respond to an increase in home GDP that reflects increase in expected return on assets. Many studies showed a negative relationship between remittances and domestic GDP, while others indicated a positive relationship (Hysenbegasi and Pozo (2002) ; Swamy (1981)). In the studies conducted by El-Sakka and McNabb (1999) and Elbadawi and Rocha (1992), this variable was not not significant. The work by Alleyne et al. (2008) suggests that this variable might be endogenous, which accounts for the inconsistency reported in the relationship between remittances and domestic GDP per capita.

For self-interested motivations, some studies have used variables designed to capture portfolio effects due to the difference between financial returns at home and host countries. Thus, the difference between the domestic and foreign interest rate may be used as an explanatory variable. In the studies by Swamy (1981) and Elbadawi and Rocha (1992), this variable was not significant while El-Sakka and McNabb (1999) reported it with negative and highly significant effect. Lianos (1997) used the foreign and domestic interest rates separately and obtained positive and significant results for the domestic interest rate, but mixed results for the foreign rate under different formulations.

Sayan (2006) investigates the correlation between workers' remittances flows and business cycles, using data from 12 developing countries during 1976-2003. This study finds evidence that the cyclicality property of remittances depends on countries.

The techniques used by the papers mentioned above to test the relationship between remittances and macroeconomic variables are generally a single-equation-based approach. To tackle the interaction problem between remittances and its potential determinants, Huang and Vargas-Silva (2006) use a VAR context and try to identify whether remittances respond to macroeconomic factors of host or home country. Huang and Vargas-Silva (2006)

use in their VAR system : net remittances sent from the U.S. (or remittances received in Mexico), variables capturing the U.S. economic activity, variables capturing Mexico economic (or weighted average of variables capturing economic activity in the five biggest recipients of remittances from the U.S - Mexico, Brazil, Colombia, El Salvador and Dominican Republic, weights given by the share of received remittances). These authors found that the host country (the U.S.) economic conditions seem to be the most important factor explaing remittances.

1.4. Impacts of remittances

1.4.1. Microeconomic impacts of remittances

1.4.1.1. Labor supply of remittances-receiving households

Remittances can impact economic development via the negative impact on the labor supply in remittances-receiving areas (Funkhouser, 1992 ; Rodriguez and Tiongson, 2001). Amuedo-Dorantes and Pozo (2006a) examine the effect of remittances on the labor supply of men and women using data on Mexican households. The authors account for endogeneity of remittances with respect to the labor-supply. One source of this endogeneity mentioned in this study is the reverse causality between remittances flows and labor-supplying in home country. In fact, remittances may impact the labor-supply decisions of individuals receiving remittances. However, the employment or unemployment at home may influence migrants' decision to remit, as mentioned in the section about the theoretical determinant of remittances. Amuedo-Dorantes and Pozo (2006a) find that remittances are accompanied by changing in the allocation of male labor supply across various type of employment. In

contrast, remittances decrease female labor supply by reducing informal-sector and non-paid work in rural areas.

1.4.1.2. Remittances and entrepreneurship

Remittances can also impact economic development by promoting microentrepreneuship by lifting budget constraints in areas with poor access to credit (Woodruff and Zenteno, 2001). Using household-level data from the Dominican communities in the Latin American Migration Project (LAMP-DR7), Amuedo-Dorantes and Pozo (2006b) study the relationship between remittances and microentrepreneuship. In order to take into account the joint determination, the authors estimate a system of simultaneous probit models. The results of this study show that remittances does not seem to promote the household's likelihood of business ownership, but business owners seem more likely than non-business owners to receive remittances. A possible explanation of such result is that the existence of a family business may indicate to the migrants the availability of good investment opportunities in home country, that supports the self-interest motives.

1.4.1.3. Remittances and education

Educational investments may be impacted by remittances (Edwards and Ureta, 2003). Using household survey data on Dominican Republic, Amuedo-Dorantes and Pozo (2006c) examine the effect of remittances on educational investments. Precisely, they examine whether remittances impact the likelihood that children have an age-appropriate education. The authors find results suggesting that remittances increase the likelihood of achieving an age-appropriate education. The result also suggest that girls seem to benefit significantly

more education than boys from remittances.

1.4.1.4. Remittances and health care

Remittances also influence heath expenditures. Using data on Mexico, Amuedo-Dorantes and Pozo (2006d) examine the impact of remittances on the health care of Mexican families by income strata. They find that remittances increase both the likelihood and level of spending on health care. The authors also find that remittances have higher impact in shaping the health care expenditures of households in lower-income quartiles.

1.4.2. Macroeconomic impacts of remittances

1.4.2.1. Remittances and poverty in the receiving countries

Remittances directly augment the income of the recipient households. In addition to providing income for poor, remittances can influence poverty and welfare through indirect multiplier impacts and also macroeconomic impacts (Ratha, 2007). Adams and Page (2005), using data on 71 developing countries, show that remittances reduce poverty. Yang and Martinez (2005) use data on Philippine households and also find that remittances reduce poverty. Taylor et al. (2005) use data from the Mexico National Rural Household Survey and find that remittances are more effective in fighting poverty.

1.4.2.2. Remittances and inequality in receiving countries

Theoretically, the effect of remittances on income inequality depends on who is migrant and remitting. As mentioned by Gonzalez-Konig and Wodon (2005) : "*If migrants come from poorer segments of the population, remittances are more likely to contribute to a*

reduction in inequality because on average poorer families are going to receive the extra income from remittances. On the other hand, if migrants tend to be better off, remittances are more likely to be inequality increasing since comparatively richer families will benefit from the extra income."

Empirically, in order to measure the impact of remittances on inequality the existing papers have compared Gini coefficients with and without the inclusion of remittance. Using the "Gini coefficients approach" on household data from two Mexican villages, Stark et al. (1986, 1988) analyzed the impact of remittances on inequality. The first village had a more recent migration (to the U.S.) experience, while the second had a longer history of migration. These papers found that the impact of remittances on income distribution depends on the village's migration history. Precisely, they showed that remittances decrease income dispersion in both villages, but this impact is more pronounced in the second village that had a longer migration tradition. Since the magnitude of migration costs depends on the village's migration history, the authors concluded that the impact of remittances on inequalities over time are influenced by the diffusion of migration-facilitating information and contacts through the village population. Based on similar methodology, Minalovic (1987) used panel data from the 1973, 1978, and 1983 Yugoslavian household surveys and found no empirical supporting the finding that remittances decrease inequality. The results from the paper by Minalovic (1987) showed that remittances tend to increase inequality and this impact differs over periods and social categories considered.

Using also the "Gini coefficients approach", McKenzie and Rapoport (2004) examined the influence of migration on inequality in a large number of Mexican rural communities. They found results indicating that the presence of migration networks, by rising the li-

kelihood of migration, generates a relationship between migration and inequality that is a Kuznets-type pattern. Precisely, at high levels of migration prevalence, migration tend to reduce income dispersion, while for the communities with a more diverse migration experience, migration seem to expand income dispersion at lower levels of migration stock.

Finally, employing the same approach on data from the Mexico National Rural Household Survey, Taylor et al. (2005) also found the equalizing influence of remittances.

1.4.2.3. Remittances and financial development in receiving countries

Remittances can promote financial development for the following reasons. Money transferred through financial system paves the way for receiving agents to access to other financial products and services (Orozco and Fedewa, 2005 ; Aggarwal et al. (2006)). In fact, by providing remittances transfer services banks get to know remittances recipients. Thus, remittances might promote credit market development if banks become more willing to grant credits to the recipients of remittances because remittances are substantial and stable. However, even if bank loans to remittances recipients do not increase, overall bank loans might increase since deposits of remittances flows increase banks' loanable funds.

Aggarwal et al. (2006) use data on workers' remittances flows to 99 developing countries during 1975-2003 to study the impact on financial sector development. In particular, they examine whether remittances contribute to increasing the aggregate level of deposits and credit intermediated by local banking sector. The authors find results suggesting that remittances promote financial development by increasing the total deposits and credits granted by the local banking sector.

More recently, Gupta et al. (2009) find the same evidence that remittances promote

financial development, using data for 44 Sub-Saharan Africa countries over the period 1975-2004.

1.4.2.4. Remittances and economic growth in receiving countries

Remittances could have a positive effect on economic growth since they finance education and health and increase investment. In countries with low level of financial development, remittances may alleviate credit constraints and acts as a substitute for inefficient financial system (Aggarwal et al., 2006). As mentioned above, remittances may also contribute to economic growth by promoting financial development. However, remittances may negatively affect economic growth because they are likely to generate moral hazard problems, then lead to decline in labor supply (Chami et al., 2003).

Empirical evidence on the growth effects of remittances remains mixed. As emphasized by Rapoport and Docquier (2005), one constraint in investigating the influence of remittances on growth was the absence of a comprehensive evidence from cross-country analysis. The first cross-country study about the effect of remittances on growth is the paper by Chami et al. (2003). Since remittances take place under asymmetric information and are likely to generate moral hazard problems (labor-supply decisions of individuals receiving remittances), they argue that remittances can have a negative impact on the economic growth of the receiving countries. Using panel data for 113 countries and employing various econometric techniques, they find results corroborating their prediction that remittances negatively affect economic growth.

On the contrary, Giuliano and Ruiz-Arranz (2009) use a data set for remittances covering about 100 developing countries, and find that remittances promote economic growth in

countries with low level of financial development by allowing an alternative way to finance investment and helping to alleviate credit constraints. However, within a theoretical framework, Mundaca (2009) shows that financial intermediaries help remittances to have a large effect on rate of growth. Using panel data for countries in Latin America and Caribbean, Mundaca (2009) finds evidence that confirms its theoretical result, i.e, remittances tend to enhance further growth if financial markets develop properly.

1.4.2.5. Remittances and real exchange rate appreciation (Dutch disease effect)

Large remittances inflows, as any other international capital, can cause the "Dutch disease" effect. The Dutch disease effect is defined as the adverse of impact of natural resources on the exportable (manufacturing) sector, associated with real exchange rate appreciation, such as was experienced by the Netherlands following the discovery of natural gas. In the case of international capital inflows such as remittances, the idea of the Dutch disease effect is the following. Through an income effect of remittances inflows, aggregate demand increases. The increase in aggregate demand causes an rise in the price of nontradable good in terms of tradable good (real exchange rate appreciation) because in the short run the supply of the nontradabe good is less than perfectly elastic. Since the price of nontradable good increases, production factors are redirected towards the sector producing this good. As a result, nontradable sector expands, while tradable sector declines.

Previous studies have examined the effect of remittances on real exchange rate. The pioneering study on the Dutch disease effect of remittances is the paper of Amuedo-Dorantes and Pozo (2004). This paper finds empirical evidence of the real exchange rate appreciation

using annual data from 1979 to 1998 for 13 Latin American and Caribbean countries.

Bourdet and Falck (2006) follow Amuedo-Dorantes and Pozo (2004) by focusing exclusively on Cape Verde from 1980 to 2000. They find evidence that remittances are associated with real exchange rate appreciation in Cape Verde.

López et al. (2007) also consider the Dutch disease phenomena by using a static computable general equilibrium model that predicts that remittances lead to real exchange rate appreciation. Considering data from 20 Latin American countries over the period 1990-2003, they find empirical evidence supporting their theoretical prediction.

Finally, using data for El Salvador and employing Bayesian techniques, Acosta et al. (2009) estimate a two-sector dynamic stochastic general equilibrium. They find that remittances lead to a Dutch disease effect, but improve the welfare of households because they help to smooth income flows and increase consumption and leisure level.

1.4.2.6. Remittances and macroeconomic stability in receiving countries

There are multiple pathways through which remittances can impact macroeconomic volatility, and these pathways lead to contradictory effects (Chami et al., 2008). If remittances are driven by altruistic motives, remittances enable recipient households to smooth their consumption over time. Therefore, if remittances are large enough, they will reduce macroeconomic volatility in remittance-receiving countries. However, as mentioned by Chami et al. (2008), remittances may tend to increase economic volatility by changing remittance recipients' behaviors. Remittance recipients will undertake riskier projects, or make less effort on their existing investment projects, leading to an increase in dispersion of investments returns and hence an increase in output volatility. Besides, due to the moral hazard

in terms of labor income, remittances may increase economic volatility, if in the presence of altruistic remittances, labor supply of remittance recipients becomes more procyclical.

To empirically examine the effect of remittances on macroeconomic volatility, Chami et al. (2008) use a cross-sectional data of 70 countries. Their empirical result suggest that a large amount of remittances allows significantly lower macroeconomic volatility in receiving countries. A recent paper by Bugamelli and Paternò (2009a) has also examined whether migrants' remittances can help to reduce output volatility. Using a cross-section of about 60 emerging and developing economies the authors find evidence that remittances reduce growth volatility.

1.5. Conclusion

The literature on the determinants and impacts of remittances is expanding. Regarding the determinants of remittances, the empirical evidence from micro surveys suggests that familial inter-temporal contracts (compared to altruism or other purely individualistic considerations) better explain the behavior of remittances (Rapoport and Docquier, 2005). As noticed by Rapoport and Docquier (2005), this finding should not ignore the importance of individualistic motives.

The different studies on macroeconomic context give contradictory results on the link between remittances and economic conditions in home country. The common evidence from preview macroeconomic studies is the positive link between remittances and an improvement in the economic conditions of host countries.

The literature on consequences of remittances points out both beneficial and adverse effects of remittances on economies of recipient countries. The potential beneficial effects of

remittances mentioned in the literature are : promoting microentrepreneuship, increasing in education, increasing in spending on health care, reducing in poverty and inequality, promoting financial development, increasing in economic growth, reducing growth volatility. Except increasing in the rate of growth, all the other potential beneficial effects of remittances were generally confirmed by evidence from the empirical studies. The empirical evidence on the growth effects of remittances is mixed, due to the potential adverse effect of remittances. The main adverse effects of remittances mentioned in the literature are the decline in labor supply and the appreciation of real exchange rate. These adverse effects were corroborated by some empirical evidences.

This thesis brings four contributions to the literature on remittances. The first contribution in Chapter 2 is about the determinants of remittances. More precisely, Chapter 2 determines the response of remittances to the macroeconomic conditions of host and home countries. Contrary to the preview papers, this empirical study in Chapter 2 is conducted using a panel VAR approach. The use of panel VAR techniques allows to benefit from both the advantages of VAR approach and panel techniques. The VAR approach addresses the endogeneity problem by allowing the endogenous interaction between the variables in the system. The endogeneity appears to be present because for (altruistic or self-interest motives) remittances can be affected by macroeconomic variables in home country, and remittances can influence consumption, investment and growth in home country. The panel techniques also tackle the problem of data limitation in developing countries and the asymptotic results are easier to derive from a panel data.

The other three contributions are about the macroeconomic impacts of remittances. Since none of the preview studies has considered the contribution of remittance shocks to

business cycles, Chapter 3 examines the role of remittance shocks in explaining macroeconomic fluctuations. A quantitative, stochastic, dynamic, three-good equilibrium model of a small open economy is constructed and calibrated to represent the economy of Senegal. Senegal is selected for two main reasons. First, Senegal is a country where remittances have become relatively high, they increase from 2.5 % of GDP in 1990 to reach 8.5 % of GDP in 2008. Second, owing to its administrative capacity, Senegal has historical series on sectoral data that are required in this study.

Chapter 4 examines the effect of the remittances on real exchange rate, using annual panel data of CFA Franc zone countries over the period from 1980 to 2007. The case of CFA Franc zone countries is particularly interesting because CFA Franc zone is a currency union, thus, the sample of CFA zone does not suffer from estimation issue linked to the exchange rate regime. In this chapter, the effects of other capital inflows (Foreign Aid, Foreign Direct Investment) on real exchange rate are also examined and, thus, compared to that of remittances.

Chapter 5 brings the final contribution and, contrary to Chapters 3 and 4, Chapter 5 is about the positive aspect of remittances. This last chapter empirically studies the effect of remittances on growth volatility, looking specifically at the interaction between remittances and the financial development. More precisely, this chapter explores how local financial sector development influences the effect of remittances on growth volatility. This empirical study is conducted using a panel of 75 countries over the period 1980-2007.

The thesis ends with a conclusion that gives a summary of the findings from the four contributions.

Chapitre 2

Response of remittances to host and home economic conditions : New evidence from a panel VAR

2.1. Introduction

The literature on the determinants of remittances is dominated by two approaches : one approach focusing on micro-economic aspects, and the other focusing on macro-economic factors. In the micro-economic approach, Lucas and Stark (1985) were the first to build a formal model for analyzing the motivations to remit. These authors point out that remittances are sent for many of reasons, ranging from pure altruism motives to pure self-interest motives. According to Lucas and Stark (1985), migrant workers can be classified as altruistic if remittances increase with

declines in family income at home, while self-interest motives would dominate if remittances were positively related with home economic performances. Some empirical papers (Lucas and Stark, 1985 ; Ilahi and Jafarey, 1999 ; Agarwal and Horowitz, 2002, Adams, 2009, among others) have tried to test the altruistic hypothesis against the self-interest hypothesis using micro-economic variables.

At the same time, other researchers have used macroeconomic variables to analyze the macroeconomic factors that impact remittances. In order to capture host economic conditions, host country GDP (income) is generally used as explanatory variable, since this variable can reflect economic prosperity of migrant in host country. Elbadawi and Rocha (1992), El-Sakka and McNabb (1999)and Lianos (1997) found a significant positive effect of host income on remittances. Some previous papers also used host unemployment rate to proxy for host economic conditions. Higgins et al. (2004) showed evidence of a significant positive effect of host unemployment rate on remittances, while Lianos (1997) found an ambiguous impact of host unemployment rate on remittances.

To capture economic conditions in home country (altruistic motivation), generally, the variable employed is GDP in home country. The idea is that, if the altruistic motives dominates, the more depressed income in the home country is, the more remittances increase. On contrary, if the self-interest motives dominates, the more expanded income in the home country is (improvement in home economic conditions), the more remittances increase. El-Sakka and McNabb (1999) and Lianos (1997) showed a non significant impact of home income on remittances, while Higgins et al.

(2004) indicated a positive relationship between home income and remittances. Higgins et al. (2004) also found that exchange rate uncertainty (a measure of risk in home country) is an important determinant of remittances.

To check for the assumption of self-interest motivations, some previous studies have also used variables designed to capture portfolio effects due to the difference in financial returns between home and host countries. Therefore, the difference between the domestic and foreign interest rates may be used to investigate self-interest motivations. The studies by Swamy (1981) and Elbadawi and Rocha (1992) did not find a significant effect of this difference in interest rates, while El-Sakka and McNabb (1999) reported it with a negative and highly significant impact. Lianos (1997) considered the foreign and domestic interest rates separately and found positive and significant impact for the domestic interest rate, but inconclusive result for the foreign interest rate under different formulations.

Sayan (2006) investigates the correlation between remittances and business cycles using data from 12 developing countries during 1976-2003. This study found that countercyclicality or procyclicality of remittances is not commonly observed across these countries.

The techniques used by the papers mentioned above to investigate the relationship between remittances and macroeconomic variables are generally a single-equation-based approach. To tackle the interaction problem between remittances and its potential determinants, Huang and Vargas-Silva (2006) employ a VAR context by investigating whether remittances respond to the macroeconomic factors of host

or home country. There is a potential causal link between remittances and home economic conditions. On the one hand, for altruistic or self-interest motives, remittances respond to home economic conditions. On the other hand, remittances can influence home economic variables. Huang and Vargas-Silva (2006) use in their VAR system : net remittances sent from the U.S. (or remittances received in Mexico), variables capturing the U.S. economic activity, variables capturing Mexico economic (or weighted average of variables capturing economic activity in the five biggest recipients of remittances from the U.S - Mexico, Brazil, Colombia, El Salvador and Dominican Republic-, weights given by the share of received remittances). These authors found evidence that the host country (the U.S.) economic conditions seem to be the most important factor explaining remittances.

Contrary to Huang and Vargas-Silva (2006), in order to examine the response of remittances to host and home country economic considerations, this chapter employs the panel VAR method. The use of panel VAR techniques allows to benefit from both the advantages of VAR approach and panel techniques. As mentioned above, the VAR approach addresses the endogeneity problem by allowing the endogenous interaction between the variables in the system. The panel techniques tackle the problem of data limitation by taking the data from various countries. Moreover, the asymptotic results are easier to derive from a panel data.

This study uses data for 14 Latin American and Caribbean countries (Belize, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua and Peru). These 14 countries were

selected in order to facilitate the choice of host country. Indeed, the United States (U.S.) is the major destination of migrant from these countries, then the U.S. is considered as the only host country.

The results from this chapter suggest that the economic conditions in host country (the U.S.) seem to be more important in explaining the fluctuations in remittances received in the 14 Latin American and Caribbean countries. By including both host and home country macroeconomic variables in panel VAR system, remittances respond significantly to host macroeconomic variables, while they do not respond to home GDP.

The remainder of the chapter is organized as follows. Section 2 presents a simple theoretical model that presents the potential macroeconomic determinants of remittances. Section 3 describes the data used in the econometric estimation. Section 4 presents the econometric methodology. Section 5 presents the empirical results and the interpretations of these empirical results. Finally, Section 6 concludes.

2.2. Theoretical framework

This section presents a simple two-period model that describes the behavior of a representative migrant born in home country and working in host country. The model presented here has the same basic implications of most other remittance models. [1]

In the first period, the migrant is assumed to maximize her or his utility by allocating her or his income between transfers to her or his family in the home

1. See Rapoport and Docquier (2005) for a review of the literature.

country, her or his own consumption in the host country and saving. The migrant has the possibility to acquire financial/non-financial assets in both countries. These assets are assumed to yield a certain rate of return. In the second period, the agent consumes the saving made in the first period.

Formally, the utility of migrant is given by :

$$U_m(C_1^m, C_2^m, C^f) = u(C_1^m) + \beta u(C_2^m) + \gamma u(C^f) \tag{2.1}$$

where $u'(C) > 0$ and $u''(C) < 0$ for $C \in \{C_1^m, C_2^m, C^f\}$ $\beta \in (0, 1]$ is the migrant's time discount rate, $\gamma \in (0, 1]$ is the degree of altruism towards the family, C_t^m is migrant's consumption at time t $(t = 1, 2)$, C^f denotes the migrant's family's consumption at home.

The resource constraints of migrants is given by the following equations :

$$C_1^m + X + I = Y^m \tag{2.2}$$

$$C_2^m = (1 + r)I \tag{2.3}$$

where X is the amount that migrant sends to sustain consumption of the family at home, I represents the amount invested of current income Y^m that migrant earns in host country and r denotes the overall portfolio return. [2]

The consumption of migrant's family C^f depends on the income earned by mi-

2. For simplicity there is no transfer cost. This assumption does not impact the results

grant's family at home, Y^f, and the remittances received from migrant, X. For simplicity, the consumption of migrant's family is additively separable in Y^f and X. Formally,

$$C^f = Y^f + X \tag{2.4}$$

The migrant's maximization program can be decomposed in two steps. In the first step, given her income in the host country, the migrant decides how much to allocate to consumption, savings and transfers to the family. Second, given total savings, the migrant solves a portfolio allocation problem, by deciding how much to invest in the home and host countries.

The first step of the representative migrant's problem is to maximize her or his utility subject to the constraints (2.2)and (2.3), in order to decides how much to allocate to consumption, savings and transfers to the family :

$$\begin{aligned} \underset{\{C_1^m, C_2^m, I, X\}}{\text{Max}} \; & u(C_1^m) + \beta u(C_2^m) + \gamma u(Y^f + X) \\ \text{subject to } & C_1^m + X + I = Y^m \\ \text{and } & C_2^m = (1+r)I \end{aligned}$$

This optimization problem can be formulated via the following Lagrangian :

$$L = u(C_1^m) + \beta u(C_2^m) + \gamma u(Y^f + X) + \lambda(Y^m - C_1^m - X - I) + \mu((1+r)I - C_2^m) \tag{2.5}$$

The optimal solution of the program is given by the following equations :

$$u'(C_1^m) = \lambda \tag{2.6}$$

$$\beta u'(C_2^m) = \mu \tag{2.7}$$

$$\lambda = \mu(1 + r) \tag{2.8}$$

$$\gamma u'(C^f) = \lambda \tag{2.9}$$

Equations (2.6) -(2.9) are the first order conditions relatively to C_1^m, C_2^m, I and X, respectively.

Combining equations (2.7) and (2.8) yields

$$\beta(1 + r)u'(C_2^m) = \lambda \tag{2.10}$$

Since $u''(C^f) < 0$ and $C^f = Y^f + X$, equation (2.9) shows that the more the degree of altruism is strong (large γ), the more remittances sent to sustain consumption, X, are large.

Using equations (2.6) and (2.10), the derivative of optimal level of remittances sent to sustain consumption in home country X^* with respect to Y^m and Y^f are given by the following equations :

$$\frac{\partial X^*}{\partial Y^m} = \frac{\beta(1+r)^2 u''(C_1^m)u''(C_2^m)}{D} > 0 \tag{2.11}$$

$$\frac{\partial X^*}{\partial Y^f} = \frac{\gamma u''(C^f)[u''(C_1^m) + \beta(1+r)^2 u''(C_2^m)]}{D} < 0 \tag{2.12}$$

where $D = \gamma u''(C^f)[u''(C_1^m) + \beta(1+r)^2 u''(C_2^m)] + \beta(1+r)^2 u''(C_1^m)u''(C_2^m) > 0$

Equation (2.11) shows that the optimal level of transfer to sustain consumption of family at home, X^*, is an increasing function of the income of migrant in host country, Y^m, i.e. migrant sends more money to sustain consumption at home if his economic conditions improve. On the contrary, equation (2.12) shows that the optimal level of transfer to sustain consumption is a decreasing function of the income of family at home, i.e migrant sends more money to sustain consumption at home if home economic conditions deteriorate.

The second step of the optimization problem is the portfolio allocation. In this step, given the optimal investment amount I^* and the exogenous return on assets in both countries r^{host} and r^{home}, the migrant chooses the asset mix I^{host} and I^{home} that maximizes the return of the portfolio. This program is formalized as follow

$$\underset{\{I^{host}, I^{home}\}}{\text{Max}} [r^{host} I^{host} + r^{home} I^{home}]$$

$$\text{subject to } I^{host} + I^{home} = I$$

The optimal choices of I^{host} and I^{home} are given as follows :

$$\begin{cases} I^{host^*} = 0 \text{ and } I^{home^*} = I^* \text{ if } r^{host} < r^{home} \\ I^{host^*} = I^* \text{ and } I^{home^*} = 0 \text{ if } r^{host} > r^{home} \\ I^{host^*} \in [0, I^*] \text{ and } I^{home^*} = I^* - I^{host^*} \text{ if } r^{host} = r^{home} \end{cases} \tag{2.13}$$

Condition (2.13) shows that self-interested remittances, I^{home}, is positively (negatively) determined by the return on assets in home (host) country. Thus, self-interest remittances are positively related to improvements in the economic conditions of home country : in response to an improvement in the economic conditions of home country, migrant sends more money in order to exploit investment opportunities in the home country.

The total amount of worker's remittances, REM, is the sum of altruistic remittances, X^*, and self-interest remittances, I^{home^*} (remittances sent in order to exploit investment opportunities in home country) : $REM = X^* + I^{home^*}$.

The results of this theoretical model, in a macroeconomic framework, can be summarized as follows. Since an increase in migrant income allows migrant to send more money for altruistic motives and to make more investment that can take place in host or home country, an improvement in the economic conditions of the host country has a positive effect on the total remittances (altruistic remittances plus self-interest remittances). While the relationship between total remittances and the conditions in the home country is ambiguous. If the altruistic motive dominates, a negative relationship is to be expected. However, since improvement in home economic conditions will reflect an increase in expected return on assets, if the motive for

remitting is to exploit investment opportunities, remittances will respond positively to improvement in the economic conditions of the home country.

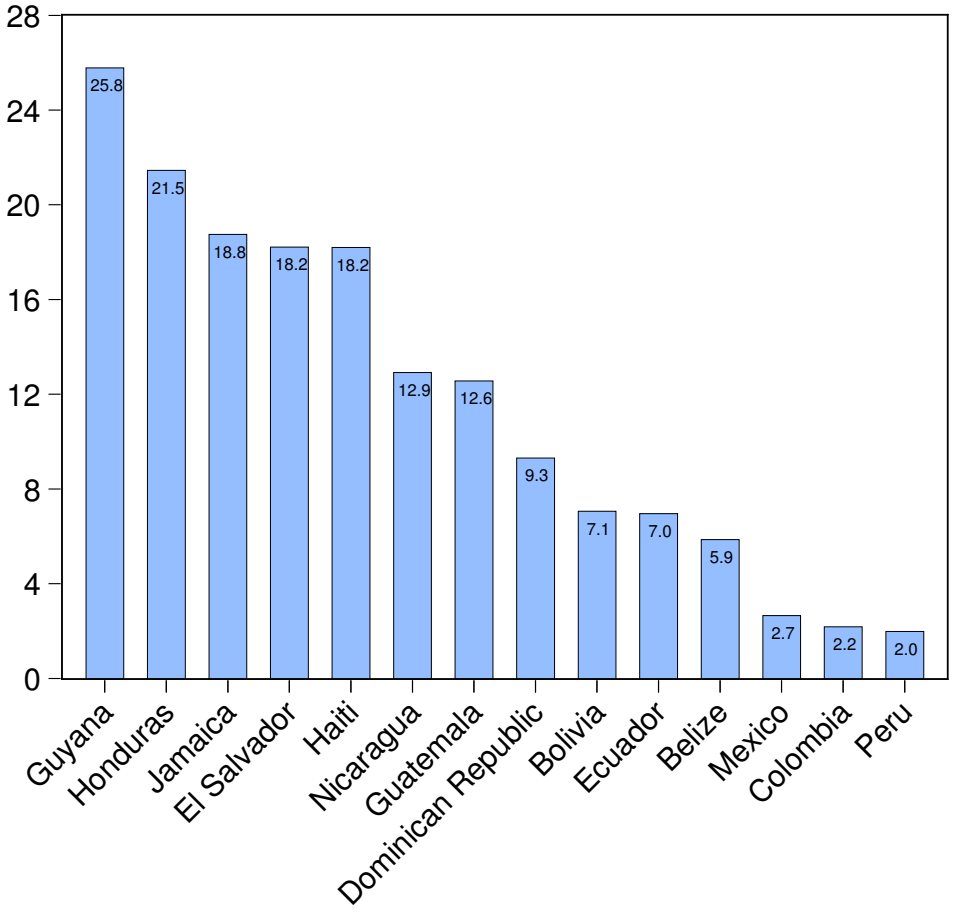
This model allows to hypothesize how the total remittances respond to changes in the economic conditions of host and home countries. The empirical section of this chapter estimates those responses.

2.3. Data

Annual data over the period 1990-2007 from 14 Latin American and Caribbean countries (Belize, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua and Peru) where remittances represent a significant part of income (Figure 2.1) are used. These 14 countries are selected in order to facilitate the choice of host country. Indeed, the United States (U.S.) is the major destination of migrant from these countries, thus the U.S. is the only host country considered (Figure 2.2). Figure 2.2 shows that the U.S. receives more than 90 percent of migrants from Mexico, Honduras, Nicaragua, El Salvador and Belize, more than 80 percent of migrants from Guatemala and Dominican Republic, more than 60 percent of migrants from Jamaica, Guyana, Colombia, Bolivia and Peru, and 54.2 percent of migrants from Ecuador. So, the U.S. macroeconomic variables are used to capture economic conditions in host country. The U.S variables used are : U.S. real GDP per capita , U.S. Federal Fund Rate (U.S. FFR). The U.S. real GDP is used to measure the income in host country. The U.S. Federal Fund rate (U.S. FFR) is used to reflect expected future changes in

U.S. economy.[3] An increase in the U.S. FFR can impact remittances through two channels. First, it should have a negative effect on the economic conditions of host country which leads to a fall in remittances. Second, it has a positive effect on return on asset of the U.S and this has a negative effect on self-interest remittances.

FIGURE 2.1 – Remittances Inflows in Latin American and Caribbean countries, 2007 (percent of GDP).

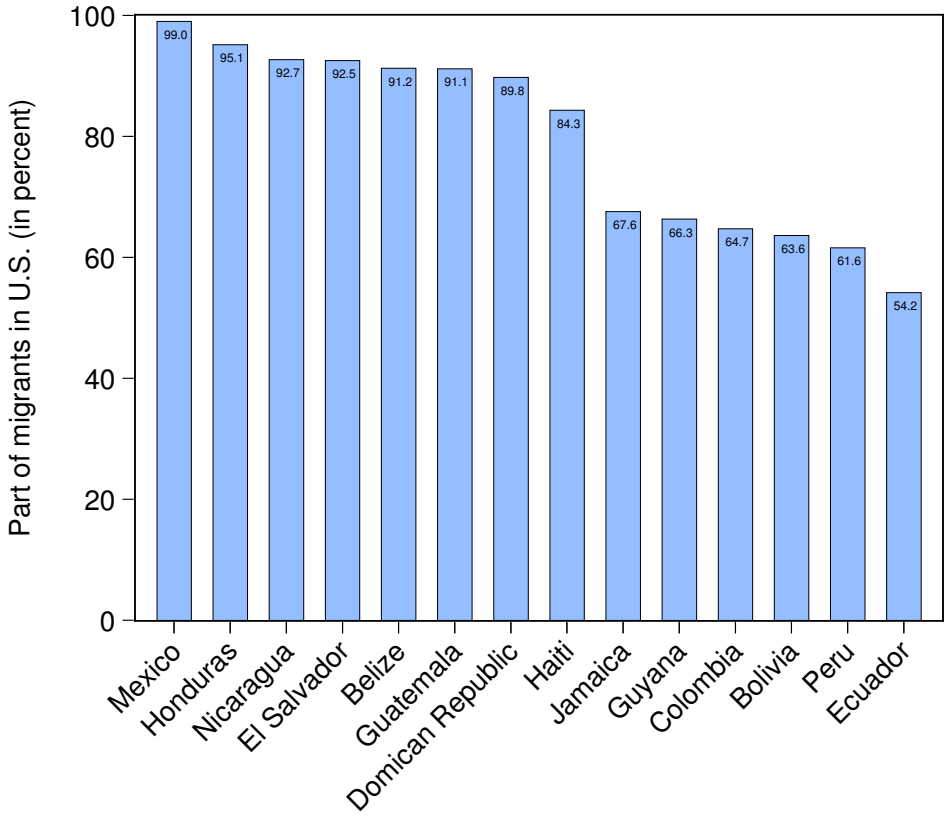


Source : WDI.

To capture the economic conditions of home country, real GDP per capita of

3. According to Bernanke and Blinder (1992), the U.S. Federal Fund Rate is the best measure of the U.S. monetary policy.

FIGURE 2.2 – Part of migrants in U.S.



Source : Database on Immigrants and Expatriates (OECD).

home country (Home GDP) is used. Real GDP of home country is used to capture improvement in economic conditions of the home country. As mentioned above, the predicted effect of this variable in a model of remittances depends on what are the motives of immigrant workers to remit. If they are altruistic, in presence of downturns in the home economy, migrant would send more money to sustain family members. On the other hand, if immigrant workers are self-interested, remittances will respond positively to an improvement in the economic conditions of the home country.

Table 2.1 reports the results of the unit root tests for the variables. Since host variables (U.S. GDP and U.S. FFR) are the same for all the countries in the panel, a standard Augmented Dickey Fuller (ADF) test is employed. For remittances (REM) and home GDP, the panel unit root test of Im, Pesaran and Shin (2003) (IPS) is employed. The results of the unit root tests show that all the variables are $I(1)$.

Table 2.2 reports the results of the seven cointegration tests (panel v test, panel rho test,panel non parametric test, panel parametric test, group mean rho test, group mean non parametric test and group mean parametric test) proposed by Pedroni (1999, 2004). These tests are based on the null hypothesis of no cointegration, and heterogeneity is allowed under the alternative hypothesis. The null hypothesis of no cointegration cannot be rejected by these tests. Particularly, the group mean parametric t-test and panel v test significantly accept the null hypothesis of no cointegration. Simulations made by Pedroni (2004) show that, in small samples ($T \approx 20$), the group mean parametric t-test is more powerful than the other tests, followed by the panel v test. As a result, the empirical properties of the variables indicate that estimating the VAR in first differences without imposing any cointegration relationships is more appropriate.

2.4. Econometric methodology

The impulse response functions (IRFs) and variance decompositions (VDC) are computed from the panel VAR. As mentioned above, the panel VAR approach allows to benefit both for the advantages of VAR approach and panel techniques. The VAR

TABLE 2.1 – Unit root test

Variables	ADF test	IPS test
$ln(U.S.GDP)$	-1.9007	
	(0.6126)	
$\Delta ln(U.S.GDP)$	-2.5127	
	(0.0155)	
$U.S.FFR$	-2.7756	
	(0.0826)	
$\Delta U.S.FFR$	-2.5127	
	(0.0155)	
$ln(REM)$		0.6223
		(0.7331)
$\Delta ln(REM)$		7.9113
		(0.0000)
$ln(HomeGDP)$		3.0703
		(0.9989)
$\Delta ln(HomeGDP)$		-6.8505
		(0.0000)

Notes : P-values are given in parentheses.

TABLE 2.2 – Panel cointegration tests

Within-dimension		
	Statistic	p-value
Panel v test	-1.0084	0.2399
Panel rho test	2.6187	0.1129
Panel non parametric test	1.9190	0.0633
Panel parametric test	1.0734	0.0734
Between-dimension		
	t-stat	p-value
Group rho test	4.1120*	0.1001
Group non parametric test	2.1241*	0.1418
Group parametric test	1.0593	0.2276

Notes : P-values are given in parentheses.

approach addresses the endogeneity problem by allowing endogenous interactions between the variables in the system. The panel techniques tackle the problem of data limitation by taking the data from various countries and the asymptotic results are easier to derive for panel data.

The initial econometric model takes the following reduced form :

$$Y_{it} = \Gamma(L)Y_{it} + u_i + \epsilon_{it} \tag{2.14}$$

Y_{it} is a vector of stationary variables including : $\Delta ln(U.S.\ GDP)$, $\Delta U.S.\ FFR$, $\Delta ln(REM)$ and $\Delta ln(Home\ GDP)$. $\Gamma(L)$ is a matrix polynomial in the lag operator with $\Gamma(L) = \Gamma_1 L^1 + \Gamma_2 L^2 + \ldots + \Gamma_p L^p$, u_i is the country specific effect and ϵ_{it} is idiosyncratic error.

An issue in estimating this model concerns the presence of fixed effects. Since fixed effects are correlated with the regressors due to lags of the dependent variable, following Love and Zicchino (2006), forward mean differencing (the Helmert procedure) is used in order to remove the fixed effects. In this procedure, all variables in the model are transformed to deviations from forward means. Let $\bar{y}_{it}^m = \sum_{s=t+1}^{T_i} y_{is}^m/(T_i - t)$ denotes the means constructed from the future values of y_{it}^m a variable in the vector $Y_{it} = (y_{it}^1, y_{it}^2, \ldots, y_{it}^M)'$, where T_i denotes the last period of data available for a given country series . Let $\bar{\epsilon}_{it}^m$ denotes the same thing of ϵ_{it}^m, where $\epsilon_{it} = (\epsilon_{it}^1, \epsilon_{it}^2, \ldots, \epsilon_{it}^M)'$. The transformations are given by :

$$\tilde{y}_{it}^{m} = \delta_{it}(y_{it}^{m} - \bar{y}_{it}) \tag{2.15}$$

and

$$\tilde{\epsilon}_{it}^{m} = \delta_{it}(\epsilon_{it}^{m} - \bar{\epsilon}_{it}^{m}) \tag{2.16}$$

where $\delta_{it} = \sqrt{(T_i - t)/(T_i - t + 1)}$. For the last year of data, this transformation cannot be calculated, since there are no future value for the construction of the forward means. The final transformed model is thus given by :

$$\tilde{Y}_{it} = \Gamma(L)\tilde{Y}_{it} + \tilde{\epsilon}_{it} \tag{2.17}$$

where $\tilde{Y}_{it} = (\tilde{y}_{it}^{1}, \tilde{y}_{it}^{2}, \ldots, \tilde{y}_{it}^{M})'$ and $\tilde{\epsilon}_{it} = (\tilde{\epsilon}_{it}^{1}, \tilde{\epsilon}_{it}^{2}, \ldots, \tilde{\epsilon}_{it}^{M})'$

This transformation is an orthogonal deviation, in which each observation is expressed as a deviation of average future observations. Each observation is weighed to standardize the variance. If the original errors are not autocorrelated and have a constant variance, the transformed errors should exhibit similar properties. Thus, this transformation preserves homoscedasticity and does not induce serial correlation (Arellano and Bover, 1995). The lagged values of regressors are used as instruments to estimate the transformed model by the generalized method of moments (GMM).

After estimating the parameters of the panel VAR, the impulse response functions (IRFs) and the variance decomposition (VDC) are computed using the Cholesky decomposition. [4] The assumption behind the Cholesky decomposition is that series listed first in the VAR order impact the other variables contemporaneously, while series listed later in the VAR order impact those listed first only with lag. Therefore, variables listed first in the VAR order are considered to be more exogenous. The U.S. GDP is placed first in the ordering, followed by the U.S. FFR. This ordering structure implies that innovations in the U.S. GDP can contemporaneously influence the implementation of monetary policy by the Federal Reserve. While, changes in the U.S. FFR will impact the U.S. GDP only with a lag. Remittances is placed after the U.S. variables and home GDP is placed last in the ordering. Then remittances are assumed to contemporaneously impact home GDP, while remittances respond to home GDP only with a lag. The robustness analysis shows that changing this ordering does not significantly impact the results.

2.5. Empirical results

This section presents the impulse response functions and the variance decomposition from the panel VAR. The correct lag length selection is essential for a VAR model : too short lags fail to capture all the system's dynamics, resulting from omitted variable bias ; while too many lags suffer from a loss of degrees of freedom,

4. The panel VAR is estimated by using the package provided by Inessa Love. This package is a Stata programs for Love (2001) and it is used in Love and Zicchino (2006).

TABLE 2.3 – Estimate results of 4-variable panel VAR(2) model

	Dependent variables			
	$\Delta ln(U.S.GDP)$	$\Delta U.S.FFR$	$\Delta ln(REM)$	$\Delta ln(HomeGDP)$
$\Delta ln(U.S.GDP)(-1)$	0.862 (8.07)***	0.695(8.07)***	5.821(1.95)**	0.325(1.17)
$\Delta ln(U.S.GDP)(-2)$	0.278(3.56)***	-0.157(-1.06)	8.148(2.46)**	0.813(1.99)**
$\Delta U.S.FFR(-1)$	-0.632(-4.94)***	0.315(3.95)***	-6.999(-2.14)**	0.470(1.34)
$\Delta U.S.FFR(-2)$	-0.089(-1.84)*	-0.141(-1.66)*	-0.757(-0.39)	0.356(2.18)**
$\Delta ln(REM)(-1)$	0.004(1.46)	-0.001(-0.509)	0.128(1.988)**	0.014(2.51)**
$\Delta ln(REM)(-2)$	0.002(0.86)	0.000(0.64)	-0.028(-0.51	-0.004(-0.63))
$\Delta ln(HomeGDP)(-1)$	(0.080)(2.21)**	0.033(1.05)	1.709(1.64)**	0.231(2.69)***
$\Delta ln(HomeGDP)(-2)$	0.034(0.90)	0.021(0.635)	0.728(0.69)	0.016(0.18)
N obs	217			

The 4-variable panel VAR (2) model is estimated by GMM, country fixed effects are removed prior to estimation (by forward mean differencing). Reported numbers show the coefficients of regressing the column variables on lags of the row variables. Heteroskedasticity adjusted t-statistics are in parentheses. *,**,***, indicate significance at 10%, 5% and 1% level, respectively.

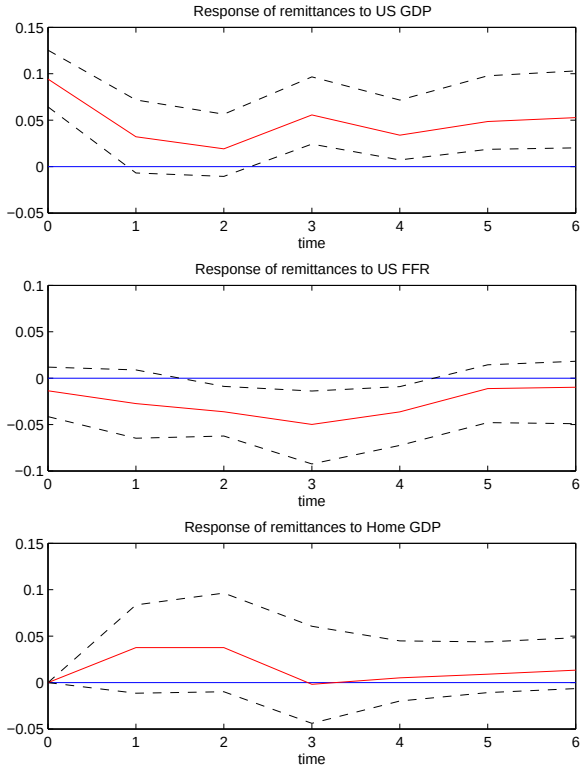
because of over-parametrization. The Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBS) indicate more than three lags as the appropriate lags for most countries. Two lags and three lags are better than one lag, and three lags are better than two lags. Greater lags than three are not possible due to a nearly singular matrix of determinants. Using the maximal lag as possible two lags are chosen. Then, the estimated panel VAR is the following :

$$\begin{pmatrix} \Delta ln(U.S.GDP) \\ \Delta U.S.FFR \\ \Delta ln(REM) \\ \Delta ln(HomeGDP) \end{pmatrix} = \Gamma_1 \begin{pmatrix} \Delta ln(U.S.GDP)(-1) \\ \Delta U.S.FFR(-1) \\ \Delta ln(REM)(-1) \\ \Delta ln(HomeGDP)(-1) \end{pmatrix} + \Gamma_2 \begin{pmatrix} \Delta ln(U.S.GDP)(-2) \\ \Delta U.S.FFR(-2) \\ \Delta ln(REM)(-2) \\ \Delta ln(HomeGDP)(-2) \end{pmatrix} + \begin{pmatrix} \epsilon_1 \\ \epsilon_2 \\ \epsilon_3 \\ \epsilon_4 \end{pmatrix}$$

The estimate results of the 4-variable panel VAR(2) are given in Table 2.3. The IRFs are displayed in Figures 2.3 and 2.4. The VDC results are reported in Tables 2.4 and 2.5

Figure 2.3 shows that remittances positively respond to a shock on U.S. GDP,

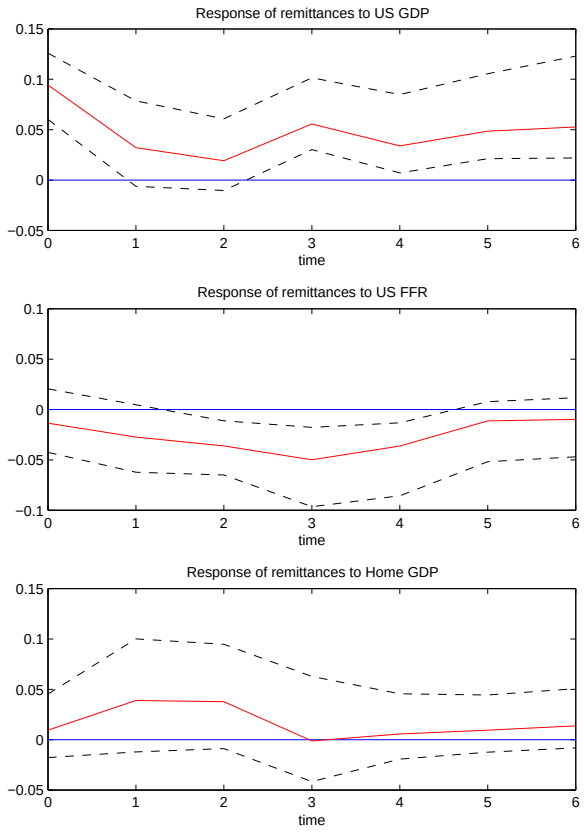
FIGURE 2.3 – Impulse responses of remittances



Notes : Estimated regressions use two lags of each variable. The Cholesky decomposition ordering is : $\Delta ln(U.S.\ GDP)$, $\Delta U.S.\ FFR$, $\Delta ln(REM)$, $\Delta ln(Home\ GDP)$. The solid line shows the response of remittances to a shock on variables in the system. The dashed lines indicate five standard confidence band around the estimate. Error are generated by Monte-Carlo with 500 repetitions

but negatively respond to a shock on U.S. FFR. The response of remittances to U.S. GDP is significant until at least seven years, and the response of remittances to U.S. FFR is significant until four periods. The response of remittances to a shock on home GDP is insignificant. The variance decomposition results in Table 2.4 confirms these findings. The results in Table 2.4 show that U.S. GDP and U.S. FFR explain about 26 and 7% of the fluctuations in remittances after 10 years, respectively. While home GDP explains only 4% of of the fluctuations in remittances after ten years.

FIGURE 2.4 – Impulse responses of remittances (changing in VAR ordering)



Notes : Estimated regressions use two lags of each variable. The Cholesky decomposition ordering is : $\Delta ln(U.S.\ GDP)$, $\Delta U.S.\ FFR$, $\Delta ln(REM)$, $\Delta ln(Home\ GDP)$. The solid line shows the response of remittances to a shock on variables in the system. The dashed lines indicate five standard confidence band around the estimate. Error are generated by Monte-Carlo with 500 repetitions

For robust analysis, the IRFs and the VDC are re-evaluated by changing the ordering in the VAR. In this new ordering, home GDP is placed before remittances, thus remittances is the last variable in the system. For this new ordering, the impulse response functions are displayed in Figure 2.4 and the variance decomposition results are reported in Table 2.5. The results from this new ordering are not significantly different to those before.

The results can be interpreted as follow. An increase in U.S GDP reflecting an improvement of migrant economic situation leads to an increase in remittances send from the U.S. An increase in U.S. FFR reflecting a monetary contraction leads to a decrease U.S. output and to a decrease in remittances sent from the U.S. The fact that remittances do not respond to home income can be interpreted as the combining of altruistic and self-interested motives leading to a mitigated effect.

To sum up, host economic conditions are an important factor driving remittance cycles while home economic conditions do not have a significant influence on remittances. This result is line with previews studies using macroeconomic variables (El-Sakka and McNabb, 1999 ; Lianos, 1997 ; and, Huang and Vargas-Silva, 2006). As mentioned above, El-Sakka and McNabb (1999) and Lianos (1997) found a positive impact of host GDP on remittances, but no significant impact of home GDP. Particularly, the findings from this chapter are very related to the results from the vector autoregressive analysis by Huang and Vargas-Silva, 2006. Using average data on Brazil, Colombia, the Dominican Republic, El Salvador, Mexico, Huang and Vargas-Silva, 2006 found that that remittances respond more to changes in the macroeconomic conditions of the U.S., than to changes in the macroeconomic conditions of the home country. The results from this chapter are also in line with the results in Sayan (2006). The paper by Sayan (2006) examines the link between remittances and business cycles of 12 developing countries over the period 1976-203. The results from this study suggest evidence that the cyclicality property of remittances depends on country under consideration.

These results suggest some important policy implications. First, since remittances seem to not respond to home economy conditions, if remittances-receiving countries want to receive more remittances they should consider individual and demographic variables (Huang and Vargas-Silva, 2006). Second, in their planning for future growth of remittances, labor-exporting countries should explicitly account for future economic prospects of the major destination countries of their emigrants.

TABLE 2.4 – Variance decomposition of remittances in Model 1

	Percentage of the variation in remittances explained by		
Horizon	U.S. GDP	U.S. FFR	Home GDP
2	13.49	0.1	0.02
5	17.08	7.11	3.37
10	25.66	7.10	4.07

Notes : estimated regressions use two lags of each variable. The Cholesky decomposition ordering is : $\Delta ln(U.S.\ GDP)$ $\Delta U.S.\ FFR$, $\Delta ln(REM)$, $\Delta ln(Home\ GDP)$.

TABLE 2.5 – Variance decomposition of remittances in Model 2

	Percentage of the variation in remittances explained by		
Horizon	U.S. GDP	U.S. FFR	Home GDP
2	13.49	1.27	2.17
5	16.27	5.74	3.67
10	25.66	7.10	4.32

Notes : estimated regressions use three lags of each variable. The Cholesky decomposition ordering is : $\Delta ln(U.S.\ GDP)$ $\Delta U.S.\ FFR$, $\Delta ln(Home\ GDP)$, $\Delta ln(REM)$.

2.6. Conclusion

This chapter examines whether the host or the home country's economic conditions influence remittances flows. To conduct this empirical study, a panel VAR approach is employed in order to benefit from both the advantages of VAR approach and panel techniques. Annual data over the period 1990-2007 from 14 Latin

American and Caribbean countries (Belize, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua and Peru). These 14 countries were selected in order to consider the U.S. as the only host country, since the U.S. is the major destination of migrant from these countries. The results from this chapter show evidence that host economic conditions seem to be an important factor driving remittances cycles, while home economic conditions do not have a significant influence remittances.

These results have some important policy implications. First, since remittances do not respond to home economic conditions, if recipients countries want to receive more remittances, they should pay attention to individual and demographic variables rather than home macroeconomic variables (Huang and Vargas-Silva, 2006). Second, in their planning for future growth of remittances, remittances recipient countries should explicitly take into account future economic prospects in the major destination countries of their emigrants. In other words, receiving countries should figure out that remittances is another channel through which host economy shocks transmit. This is particularly relevant for countries that receive a high amount of remittances.

Since remittances are explained by exogenous factors that are independent of home business cycles, and, since remittances can impact home economy, remittance shocks can be considered as a source of fluctuations of home economy. This is the goal of the next chapter.

Appendix

A.1. Countries included in the sample

These fourteen home countries are : Belize, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua and Peru. The United States is the only host country.

A.2. Variables and their sources

This appendix provides the definition and data sources for the variables used in the regressions that are reported in this chapter.

- Remittances : Sum of worker's remittances, migrant transfers in real terms (constant 2000 US$). The data source is World Development Indicator (World bank).
- Home GDP : Real GDP per capita (constant 2000 US$) of home country. The data source is World Development Indicator (World Bank).
- U.S (Host) GDP :Real GDP per capita (constant 2000 US$) of United States. The data source is World Development Indicator (World Bank).
- U.S. FFR : U.S. Federal Funds Rate. The data source is International Financial Statistics (International Monetary Fund).

Chapitre 3

Remittances, real exchange rate and macroeconomic fluctuations

3.1. Introduction

Many studies have examined the determinants of the fluctuations in remittance inflows. As shown in Chapter 2, remittances can be viewed as a combination of altruistic and self-interested motives and the major determinants of the fluctuations in remittances are variables that capture economic conditions in home and host countries. Remittances will countercyclically move with home business cycles if the altruistic motives are the dominant motives, while they will procyclical move with home business cycles if self-interested motives are the dominant motives. The empirical results show that the cyclicality of remittances in respect to home cycles depends on countries (Sayan, 2006). Moreover, remittances respond more to changes

in the macroeconomic conditions of the host country, than to changes in the macroeconomic conditions of the home country (Huang and Vargas-Silva, 2006 and Chapter 2). The current economic crisis corroborates this result, because remittance inflows to developing countries are falling. So, remittances seem to be more explained by exogenous factors that are independent of home business cycles. Even if, on average, remittances are relatively more stable than other capital flows, since the size of remittances are large in some countries, the exogenous fluctuations in remittances can hugely impact business cycles in these countries. Therefore, this chapter examines the contribution of remittance shocks to macroeconomic fluctuations. In order to analyze the contribution of remittances to macroeconomic fluctuations, this chapter uses a dynamic stochastic general equilibrium model calibrated on Senegal's economy. The exogenous, procyclical or counter-cyclical nature of the remittances in Senegal is taken from Senegal data, instead of assuming a particular reasons to remit (altruistic or self-interested motive). Senegal is selected for man reasons. First, Senegal is a country where remittances have become relatively high, they increase from 2.5% of GDP in 1990 to reach 8.5% of GDP in 2008. Second, thanks to its administrative capacity, Senegal has historical series on sectoral data that are required in the study.

This chapter is closely related to some studies focusing on the dynamics of business cycles in developing countries, such as Mendoza (1995), Kose and Riezman (2001) and Kose (2002) among others. Mendoza (1995) investigates the contribution of terms of trade shocks in explaining business cycles of a small open economy

model calibrated for a typical developing economy. This study shows evidence that the terms of trade shocks explain almost half of output fluctuations. Kose and Riezman (2001) extends the model of Mendoza (1995) to show that trade shocks explain roughly half of economic fluctuations in aggregate output in Africa. Using this same model, Kose (2002) shows that world price shocks have a significant contribution of volatility in developing countries. This chapter contributes to this literature on the sources of fluctuations in developing countries by examining the quantitative importance of remittances fluctuations in explaining the business cycles of Senegal.

The structure of the model in this chapter is three-good model (exportable good, imported good and non-tradable good). Using this model, the contribution of remittances to macroeconomic fluctuations is quantitatively explored, i.e. how important the remittances fluctuations are in explaining the fluctuations of domestic macroeconomic variables such as, aggregate output, consumption, and real exchange rate. The results indicate that remittances play an important role in the macroeconomic fluctuations in Senegal. In particular, remittance shocks explain about 10% of the volatility of aggregate output and consumption and about 20% of the volatility of real exchange rate.

The remainder of the chapter is organized as follows. Section 2 presents the dynamic of remittances and some stylized facts of business cycles in Senegal. Section 3 describes the model. The model calibration is described in Section 4. Section 5 presents the ability of the model in replicating the major features of business cycle in Senegal. The model dynamics are analyzed using impulse responses and the contri-

bution of remittances fluctuations to the business cycles of Senegal is quantitatively evaluated. Following this, the sensitivity of the results is investigated. Section 6 concludes with a summary.

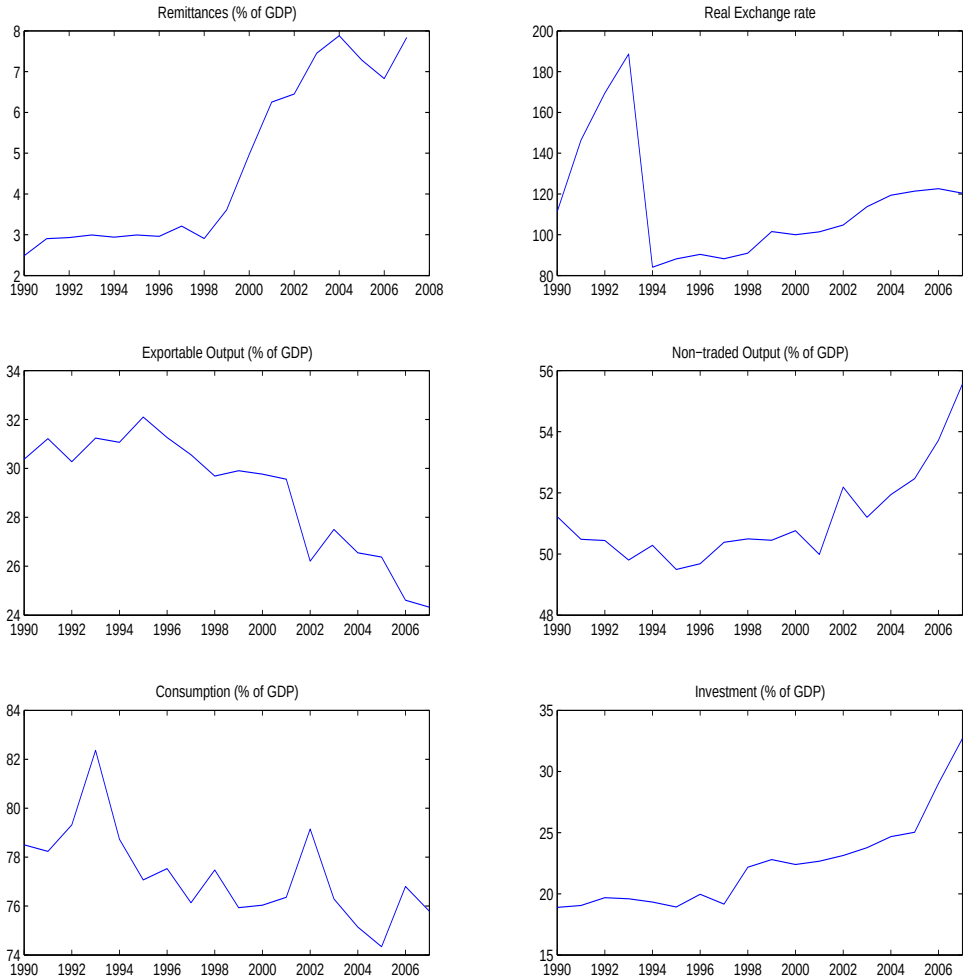
3.2. Remittances and some stylized facts of business cycles in Senegal

Senegal, a former French colony, is a country with a population of 12.4 million in 2007 and average 1990-2007 per capita GDP of about USD 1200 PPP terms. Senegal is among the top remittances-recipient in Africa. Remittances received in Senegal increase from 124 USD million (2.5% of GDP) in 1990 to reach 925 USD million in 2007 (8.3% of GDP) [1]. Figure 3.1 summarizes key economic indicators of Senegal. Consistent with the Dutch disease hypothesis, the real exchange rate rapidly appreciates and non-tradable output increases while exportable output falls.

Table 3.1 documents the business cycles statistics of Senegal. Even remittances are viewed as external resources flows, remittances received in Senegal are more volatile than other key variables considered in Table 3.1. The persistence of remittances is about 0.64. Remittances are positive correlated to GDP, consumption, non-tradable output and real exchange rate, negative correlated to exportable output, investment and trade balance.

1. The definition of remittances is the same as in Chapter 2.

FIGURE 3.1 – Selected indicators of Senegal, 1990-2007



Source : World Development Indicators, author' calculations. Real Exchange Rate is the Real Effective Exchange Rate that is calculated as a weight geometric average of the level of consumer prices in Senegal relative to that of its trading partners, expressed in common currency. Exportable output is approximated by agriculture and manufacturing and non-tradable output is approximated by services.

TABLE 3.1 – Business cycle statistics of Senegal (from 1990 to 2008)

Variable	Volatility	Relative Volatility	Persistence	Correlation with GDP	Correlation with Remittances
GDP (Y)	1.70	1	0.49	1	0.43
Exportable Output (Y_X)	3.33	1.95	0.38	0.60	-0.27
non-tradable Output (Y_N)	1.78	1.05	0.18	0.80	0.24
Consumption (C)	2.30	1.35	0.70	0.43	0.230
Investment (I)	6.43	4.59	0.44	0.41	-0.09
Remittances (REM)	10.18	5.99	0.64	0.43	1
Real Exchange Rate (RER)	18.00	10.60	0.63	0.35	0.44
Net export (NX)	1.30	0.89	0.52	-0.37	0.52

Notes : Sample moments for Senegal are calculated using data with a sample length from 1990 to 2008. The data come from WDI online. All series are logged (except current account) and filtered using an HP filter with a smoothing parameter of 100. Volatility is the percentage deviation from the HP trend. Relative volatility is the standard deviation of the respective variable relative to the standard deviation of the output. Persistence is the first-order serial autocorrelation.

3.3. Model

3.3.3. Households

The structure of the model is similarly to that in Kose and Riezman (2001) in which remittances are included.[2] The economy is inhabited by a large number of infinitely lived, identical households. The representative household's objective function is given by

$$E_0\sum_{t=0}^{\infty}\beta^t U_t \text{ where } U_t = \frac{1}{1-\sigma}{C_t}^{1-\sigma} - \frac{\chi}{1+\varsigma}(L_t)^{\varsigma}, \quad \beta,\sigma,\chi,\varsigma > 0 \tag{3.1}$$

where β denotes the discount factor, σ is the risk aversion parameter, ς governs the intertemporal elasticity of substitution in labor supply and χ is a parameter used to set the steady state level of labor hours. L_t is labor supply and C_t is a composite of tradable good $C_{T,t}$ and non-tradable good, $C_{N,t}$. The functional form of the composite good is represented by a CES aggregation, as follow

2. Kose (2002) has used a similar model.

$$C_t = [\omega(C_{T,t})^{-\mu} + (1-\omega)(C_{N,t})^{-\mu}]^{\frac{-1}{\mu}} \tag{3.2}$$

where $\omega \in [0,1]$ is the share of tradable goods in total consumption, and $1/(1+\mu) > 0$ is the intratemporal elasticity of substitution between tradable and non-tradable goods.

The tradable good $C_{T,t}$, a composite of exportable good, $C_{X,t}$, and importable good, $C_{M,t}$, is given by

$$C_{T,t} = C_{X,t}^{\gamma} C_{M,t}^{1-\gamma} \tag{3.3}$$

where $\gamma \in [0,1]$ is the share of exportable good in tradable good consumption.

Using imported good as numeraire, the total expenditure of consumption can be expressed as the sum of expenditure on each good :

$$P_t C_t = P_{X,t} C_{X,t} + C_{M,t} + P_{N,t} C_{N,t} \tag{3.4}$$

where P_t is the price of composite good C_t in terms of imported good, $P_{X,t}$ denotes the price of exportable good in terms of imported good, and $P_{N,t}$ is the price of non-tradable good in terms of imported good.

The household's budget constraint (in terms of imported good) is the following equation :

$$B_{t+1} + \frac{\psi}{2}(B_{t+1} - \bar{B}) + P_t C_t + I_{X,t} + P_{N,t} I_{N,t} =$$

$$\leq w_t L_t + (1 + i_t^*) B_t + r_{X,t} K_{X,t} + r_{N,t} P_{N,t} K_{N,t} + REM_t \tag{3.5}$$

The representative household enters each period t with holding of foreign bonds (B_t) and earns a real interest rate (i_t^*) on bonds held from the previous period t, where $\frac{\psi}{2}(B_{t+1} - \bar{B})$ is a cost of adjusting foreign bond holdings relative to its steady state level $\bar{B}$, used to guarantee steady-state determinacy and model stationarity in reaction to transitory shocks. This cost can be interpreted as financial intermediation cost, where the financial intermediaries, owned by domestic households, are assumed to be local perfectly competitive firms (Acosta et al., 2009). $K_{X,t}$ and $K_{N,t}$ are capital stocks in exportable and non-tradable sectors, respectively. $I_{X,t}$ and $I_{N,t}$ are investments in exportable and non-tradable sectors, respectively. Investment in exportable sector, $I_{X,t}$, is imported, while investment in non-tradable sector, $I_{N,t}$ is domestically produced by non-tradable sector. w_t is real wage paid to labor supply. The household also receives remittances REM_t from emigrants working abroad. The remittance inflows are given by a stochastic process $REM_t = \bar{REM} exp(\xi_t)$, where $\bar{REM}$ is the steady state level of remittances and ξ_t is the stochastic component of remittances.

3.3.3. Firms

The economy produces exportable goods and non-tradable final goods.

3.3.3.1. Exportable sector

The exportable sector produces the primary good. The production of primary goods, $Y_{X,t}$, requires the use of labor, $L_{X,t}$, imported capital, $K_{X,t}$, and land, Q, which is assumed to be inelastically supplied. The technology used in the primary sector is given by Cobb-Douglas function

$$Y_{X,t} = A_{X,t} L_{X,t}^{\alpha_1} K_{X,t}^{\alpha_2} Q^{1-\alpha_1-\alpha_2} \tag{3.6}$$

where $A_{X,t}$ is the exogenous productivity shock. α_1 and α_2 are labor and capital income shares, respectively. The modeling of primary goods production is similar to that in Kose and Riezman (2001). Since production of primary goods requires substantial amount of land input in African economies (particularly in Senegal), land is introduced in the primary production. As mentioned by Kose (2002), this dampens the volatility of the primary sector output by reducing the substitution effects across different factors. As result, by decreasing volatility of aggregate output, introducing land allows the model to generate realistic volatility properties.

Capital accumulation in exportable sector is modeled as follows

$$K_{X,t+1} = (1-\delta)K_{X,t} + I_{X,t} - \frac{\phi_X}{2}\left(\frac{I_{X,t}}{K_{X,t}} - \delta\right)^2 K_{X,t} \tag{3.7}$$

where δ is the depreciation rate and ϕ_X governs the size of the installation cost. The adjustment costs is introduced to prevent excessive volatility of investment. [3]

3. See Baxter and Crucini (1993) for details.

3.3.3.2. Non-tradable sector

The non-tradable final good production, $Y_{N,t}$, uses labor, $L_{N,t}$, domestically produced capital, $K_{N,t}$, and intermediate inputs, S_t. The technology in the non-tradable sector is given by CES function

$$Y_{N,t} = A_{N,t} L_{N,t}^{\theta} \left[\eta K_{N,t}^{-u} + (1-\eta) S_t^{-u}\right]^{-(1-\theta)/u}, \quad 0 < \theta, \eta, u < 1 \tag{3.8}$$

where $A_{N,t}$ is the exogenous productivity factor in the non-tradable sector.

Capital accumulation in non-tradable sector is given by

$$K_{N,t+1} = (1-\delta) K_{N,t} + I_{N,t} - \frac{\phi_N}{2} \left(\frac{I_{N,t}}{K_{N,t}} - \delta\right)^2 K_{N,t} \tag{3.9}$$

3.3.3. Resource constraints

The household faces the following labor-leisure allocation constraint

$$L_{X,t} + L_{N,t} = L_t \tag{3.10}$$

The resource constraint for the non-tradable goods sector is given by

$$C_{N,t} + I_{N,t} = Y_{N,t} \tag{3.11}$$

The resource constraint for the exportable sector is

$$P_{X,t} C_{X,t} + C_{M,t} + I_{X,t} + S_t + NX_t = P_{X,t} Y_{X,t} \tag{3.12}$$

where NX_t is the net export.

The gross domestic product (GDP) in terms of imported goods is given by

$$Y_t = P_{X,t}Y_{X,t} + P_{N,t}Y_{N,t} \tag{3.13}$$

The total investment in the economy in terms of imported goods is

$$I_t = I_{X,t} + P_{N,t}I_{N,t} \tag{3.14}$$

3.3.3. Equilibrium conditions

The household chooses tradable and non-tradable goods to minimize expenditure conditional on consuming one unit of the consumption index. The optimal allocation of expenditure between the tradable and non-tradable goods yields the standard isoelastic demands :

$$C_{T,t} = \omega^{1/(1+\mu)} \left(\frac{P_t}{P_{T,t}} \right)^{1/(1+\mu)} C_t \tag{3.15}$$

$$C_{N,t} = (1-\omega)^{1/(1+\mu)} \left(\frac{P_t}{P_{N,t}} \right)^{1/(1+\mu)} C_t \tag{3.16}$$

The household also chooses exportable and importable goods to minimize expenditure conditional on consuming one unit of tradable consumption. Optimal allocation of expenditure between the exportable and importable goods gives

$$C_{X,t} = \gamma \left(\frac{P_{T,t}}{P_{X,t}} \right) C_{T,t} \tag{3.17}$$

$$C_{M,t} = (1-\gamma) P_{T,t} C_{T,t} \tag{3.18}$$

The representative household maximizes

$$\text{Max } E_0 \sum_{t=0}^{\infty} \beta^t U_t$$

subject to

$$B_{t+1} + \frac{\psi}{2} \left(B_{t+1} - \bar{B} \right)^2 + P_t C_t + I_{X,t} + P_{N,t} I_{N,t}$$

$$\leq w_t L_t + (1 + r_t^*) B_t + r_{X,t} K_{X,t} + r_{N,t} P_{N,t} K_{N,t} + \tau_t + REM_t \quad (\lambda_t)$$

$$K_{X,t+1} = (1-\delta) K_{X,t} + I_{X,t} - \frac{\phi_X}{2} \left(\frac{I_{X,t}}{K_{X,t}} - \delta \right)^2 K_{X,t} \quad (\mu_{1,t})$$

$$K_{N,t+1} = (1-\delta) K_{N,t} + I_{N,t} - \frac{\phi_N}{2} \left(\frac{I_{N,t}}{K_{N,t}} - \delta \right)^2 K_{N,t} \quad (\mu_{2,t})$$

where λ_t, $\mu_{1,t}$ and $\mu_{2,t}$ are the Lagrange multipliers. The first-order conditions are

$$C_t^{-\sigma} = P_t \lambda_t \tag{3.19}$$

$$\beta E_t\left[\lambda_{t+1}(1+i^*_{t+1})\right] = \lambda_t\left[1+\psi(B_{t+1}-\bar{B})\right] \tag{3.20}$$

$$L^s_t = \lambda_t w_t \tag{3.21}$$

$$\mu_{1,t}\left[1-\phi_X(\frac{I_{X,t}}{K_{X,t}}-\delta)\right] = \lambda_t \tag{3.22}$$

$$\mu_{2,t}\left[1-\phi_N(\frac{I_{N,t}}{K_{N,t}}-\delta)\right] = \lambda_t \tag{3.23}$$

$$\beta E_t\left[\lambda_{t+1}r_{X,t+1}-\mu_{1,t+1}\left(\frac{\phi_X}{2}\left(\frac{I_{X,t}}{K_{X,t}}-\delta\right)^2+\phi_X\frac{I_{X,t}}{K_{X,t}}(\frac{I_{X,t}}{K_{X,t}}-\delta)+(1-\delta)\right)\right] = \mu_{1,t} \tag{3.24}$$

$$\beta E_t\left[\lambda_{t+1}r_{N,t+1}-\mu_{2,t+1}\left(\frac{\phi_N}{2}\left(\frac{I_{N,t}}{K_{N,t}}-\delta\right)^2+\phi_N\frac{I_{N,t}}{K_{N,t}}(\frac{I_{N,t}}{K_{N,t}}-\delta)+(1-\delta)\right)\right] = \mu_{2,t} \tag{3.25}$$

Equation (3.20) indicates that the marginal utility of a unit of consumption good forgone at time t, in terms of foreign bonds, must equalize the expected discounted marginal utility of a unit of that good at time $t+1$.

Equation (3.21) implies that the ratio of marginal disutility from supplying a unit of labor over the marginal utility of consumption must be equal to the real

wage.

Equations (3.24) and (3.25) represent the intertemporal efficiency condition governing the domestic capital stocks.

The profit of firms in exportable sector (in terms of imported goods) is

$$\Pi_{X,t} = P_{X,t}A_{X,t}L_{X,t}^{\alpha_1}K_{X,t}^{\alpha_2}Q^{1-\alpha_1-\alpha_2} - w_tL_{X,t} - r_{X,t}K_{X,t} \tag{3.26}$$

The optimal conditions for firms in exportable sector are :

$$\alpha_1 P_{X,t}A_{X,t}L_{X,t}^{\alpha_1-1}K_{X,t}^{\alpha_2}Q^{1-\alpha_1-\alpha_2} = w_t \tag{3.27}$$

$$\alpha_2 P_{X,t}A_{X,t}L_{X,t}^{\alpha_1}K_{X,t}^{\alpha_2-1}Q^{1-\alpha_1-\alpha_2} = r_{X,t} \tag{3.28}$$

Equation (3.27) implies that labor is demanded so that the marginal product of labor equals the real wage. Equation (3.28) shows that the marginal product of capital in exportable sector must equal the real interest rate on capital used in that sector.

The profit of firms in non-tradable sector (in terms of imported goods) is

$$\Pi_N = P_{N,t}A_{N,t}L_{N,t}^{\theta}\left[\eta K_{N,t}^{-u} + (1-\eta)S_t^{-u}\right]^{-(1-\theta)/u} - w_tL_{N,t} - r_{N,t}P_{N,t}K_{N,t} - S_t \tag{3.29}$$

The optimal conditions for firms in non-tradable sector are :

$$\theta P_{N,t} A_{N,t} L_{N,t}^{\theta-1} \left[\eta K_{N,t}^{-u} + (1-\eta) S_t^{-u}\right]^{-(1-\theta)/u} = w_t \tag{3.30}$$

$$\eta(1-\theta) A_{N,t} K_{N,t}^{-u-1} L_{N,t}^{\theta} \left[\eta K_{N,t}^{-u} + (1-\eta) S_t^{-u}\right]^{-(1-\theta)/u-1} = r_{N,t} \tag{3.31}$$

$$(1-\eta)(1-\theta) P_{N,t} A_{N,t} S_t^{-u-1} L_{N,t}^{\theta} \left[\eta K_{N,t}^{-u} + (1-\eta) S_t^{-u}\right]^{-(1-\theta)/u-1} = 1 \tag{3.32}$$

Equation (3.30) implies that the marginal product of labor demanded by firm in non-tradable sector must equal the real wage. Equation (3.31) shows that the marginal product of capital in non-tradable sector must equal the real interest rate on capital used in that sector. Equation (3.32) implies that imported intermediate input is demanded up to the point where the marginal product of imported intermediate input equals the import price that is normalized to one.

Equations (3.27) and (3.30) yield

$$\alpha_1 P_{X,t} A_{X,t} L_{X,t}^{\alpha_1-1} K_{X,t}^{\alpha_2} Q^{1-\alpha_1-\alpha_2} = \theta P_{N,t} A_{N,t} L_{N,t}^{\theta-1} \left[\eta K_{N,t}^{-u} + (1-\eta) S_t^{-u}\right]^{-(1-\theta)/u} \tag{3.33}$$

Since labor is mobile across sectors, equation (3.33) implies that the marginal product of labor is the same in the two sectors.

3.3.3. The foreign economy

A small open economy is characterized by the fact that it cannot affect foreign economy. Thus, all foreign variables are given exogenously, particularly the terms of trade (the price of exports relative to the price of imports) (TOT) and the world interest rate (i^*). Since the imported good is used as the numeraire and import price is the only foreign price considered in this model, the terms of trade are given by $TOT = P_{X,t}$. For the same reason, the real exchange rate is equal to the general price level of the economy, $RER_t = P_t$. This implies that real appreciation of domestic currency is equivalent to an increase in the real exchange rate.

3.3.3. Exogenous shocks

In the model economy, there are five kinds of exogenous shocks : two sectoral (exportable and non-tradable) productivity shocks, world interest rate shocks, terms of trade shocks and remittance shocks. The vector of these shocks is given as follows $Z_t = [ln(A_{X,t}), ln(A_{N,t}), i_t^*, ln(TOT_t), \xi_t]'$. Z_t is assumed to follow a first order Markov process :

$$Z_{t+1} = \Pi Z_t + \varepsilon_t \tag{3.34}$$

where ε_t is the vector of innovations $\varepsilon_t = [\varepsilon_{X,t}, \varepsilon_{N,t}, \varepsilon_{r,t}, \varepsilon_{TOT,t}, \varepsilon_{REM,t}]'$ and $\varepsilon_t \sim \mathcal{N}(0, \Sigma)$

3.4. Model calibration

3.4.4. Preference and technology parameters and steady state

The model is calibrated at annual frequency with parameter values that are consistent with the main features of Senegal's economy (Table 3.2). Following Kose and Riezman (2001), the risk aversion parameter, σ, is set to 2.61. In accordance with the real business cycle literature, the household discount factor, β is fixed to 0.97, so that the annual real interest rate is 4 % . Following Mendoza (1995), the share of tradable goods in the consumption basket, ω, is set to 0.5, and, the share of exportable good in tradable good, γ, is fixed to 0.60. Following Kose and Riezman (2001), the elasticity of labor supply, χ, is fixed to 0.83. The parameter associated with the disutility of labor supply, ν, is set to 1. The depreciation rate, δ, is set to 0.1. $\bar{B}$ is set so that steady state debt is 65 % of GDP, approximately the average value of Senegal during the period 1990-2008. In line with the literature on small open economy models, the parameter of bond adjustment cost, ψ, is fixed to 0.06. The steady state value of remittances is set to 5 % of GDP which is the average value observed in Senegal economy during the period 1990-2008. Following Kose and Riezman (2001), the shares of labor and capital in exportable sector, α_1 and α_2, are set to 0.37 and 0.18, respectively. Following Kose and Riezman (2001), the share of labor in non-tradable sector, θ, is set to 0.45. The relative weight of capital, η, is set to 0.55. The value of the elasticity of substitution between capital and intermediate goods for non-tradable sector, u, is fixed to 0.58. The value for the

parameter associated with the adjustment cost of capital, ϕ_X and ϕ_N, are set to 2.2 and 2, respectively, as in Kose and Riezman (2001).

TABLE 3.2 – Benchmark calibration

Symbol	Value	Description
σ	2.61	Coefficient of relative risk aversion
β	0.97	Household's discount factor
ω	0.5	Share of tradable good in consumption basket
γ	0.6	Share of exportable good in tradable good
ν	0.83	Elasticity of labor supply
χ	1	Coefficient on labor in utility
ψ	0.06	Coefficient on adjustment cost for bond holding
δ	0.1	Rate of capital depreciation
α_1	0.37	Share of labor in exportable sector
α_1	0.18	Share of capital in exportable sector
θ	0.45	Share of labor in non-tradable sector
η	0.55	Relative weight of capital in non-tradable sector
u	0.58	Elasticity of subt. between capital and intermediate goods
ϕ_X	2.2	Elasticity of marginal adjustment cost in exportable sector
ϕ_N	2	Elasticity of marginal adjustment cost in non-tradable sector

3.4.4. Exogenous shocks

Productivity shocks : Following Kose and Riezman (2001), the total factor productivity in each sector is estimated by using the formula of the Solow residual in logarithms :

$ln(A_{X,t}) = ln(Y_{X,t}) - \alpha_1 ln(L_{X,t})$ and $ln(A_{N,t}) = ln(Y_{N,t}) - \theta ln(L_{N,t})$

The capital stock and intermediate input are excluded from the formula for the following reasons mentioned by Kose and Riezman (2001). First, as argued by Kose and Riezman (2001), fluctuations in the capital stock are weak in the short-run. Second, the contemporaneous correlation between the capital stock and production can be negligible. Third, for developing countries, particularly for Senegal, the data

on intermediate input is unavailable.

Exportable output, Y_X, is proxied by the total real value added of manufacturing and agricultural output, and, non-tradable output, Y_N, is proxied by the real value added industry and service output. Since data on sectoral labor hours is not available, L_X and L_N are proxied by the total employment index.

World real interest rate shocks : The world real interest rate is proxied by the constant maturity yield on three-month US Treasury bills rate deflated by US inflation [4].

Terms of trade shocks : The terms of trade is measured by the ratio of dollar export prices to dollar import prices of Senegal.

Remittance shocks : Some empirical studies show that remittances mainly respond to economic conditions in the host, and other external factors such as a reduction in transaction costs increase the amount to remit. However, other empirical studies show that remittances response to economic conditions in home country. The response of remittance flows to cyclical fluctuations in economic activity at home is different according to whether remittances are driven by altruistic or self-interested motives. Even if remittances can be driven by self-interested motives, in contrast to other capital flows, remittances do not induce in the future any liabilities such as debt services or profit transfers (Sayan, 2006). So, in this study, the exogenous,

4. This is commonly used in the literature on business cycles (Mendoza, 1995 ; Kose and Riezman, 2001 ; Kose, 2002)

pro-cyclical or counter-cyclical nature of the remittances in Senegal is taken from the data, instead of assuming a particular motive (altruistic or self-interested) to remit.

The estimated parameters of the persistence of shocks in equation (3.34) are the following :

$$\mathbf{\Pi} = \begin{bmatrix} 0.86 & 0 & 0 & 0 & 0 \\ 0 & 0.89 & 0 & 0 & 0 \\ 0 & 0 & 0.67 & 0 & 0 \\ 0 & 0 & 0 & 0.93 & 0 \\ 0 & 0 & 0 & 0 & 0.94 \end{bmatrix}$$

The estimated variance-covariance matrix of innovations is :

$$\mathbf{\Sigma} = \begin{bmatrix} 0.020^2 & 0 & 0 & 0 & 0 \\ -0.280 & 0.011^2 & 0 & 0 & 0 \\ 0.075 & -0.005 & 0.009^2 & 0 & 0 \\ -0.053 & 0.144 & 0.187 & 0.0.032^2 & 0 \\ 0.534 & -0.035 & 0.042 & -0.028 & 0.17^2 \end{bmatrix}$$

3.5. Results

3.5.5. Business cycle properties

In this subsection, I examine whether the model is able to reproduce the main characteristics of Senegal's business cycles. To this end, the business cycle moments (volatility, correlation, and persistence) are computed by simulating the model. These

moments are obtained by averaging over 1000 simulations each of which has 18 observations (1990-2008). To make reliable comparison, both the artificial series simulated by the model and the actual data are detrended by HP(100) filter. Table 3.3 reports the simulated and actual moments.

TABLE 3.3 – Business cycle properties

	Y	Y_X	Y_N	C	I	REM	RER	L	NX
Volatility									
Data	1.70	3.33	1.78	2.30	6.43	10.18	18.00	2.19	1.30
Benchmark Model	2.08	5.10	4.38	6.74	5.64	7.98	7.07	3.40	2.18
Model without Remit. shocks	1.99	4.49	1.10	1.90	5.35	0	1.51	2.80	1.37
Model with Remit. shocks only	0.40	0.65	0.36	0.42	0.74	8.94	2.05	0.60	0.05
Relative Volatility									
Data	1	1.95	1.05	1.35	4.59	5.99	10.59	1.60	0.89
Benchmark Model	1	2.45	2.82	3.24	2.71	3.83	3.39	1.80	1.04
Correlation with GDP									
Data	1	0.60	0.80	0.43	0.41	0.43	0.35	0.81	-0.14
Benchmark Model	1	0.96	0.66	0.91	2.71	0.46	0.27	0.67	-0.20
Correlation with Remit.									
Data	0.43	0.27	0.24	0.30	-0.09	1	0.44	-0.17	-0.30
Benchmark Model	0.46	-0.45	0.17	0.23	-0.11	1	0.47	-0.30	-0.32
Persistence									
Data	0.49	0.38	0.18	0.70	0.44	0.64	0.63	0.40	0.52
Benchmark Model	0.86	0.92	0.78	0.86	0.74	0.89	0.87	0.67	0.58

Notes : Both the artificial series simulated by the model and the actual data are logged (except current account) and detrended by HP(100) filter. For the actual data, volatility is the percentage deviation from the HP trend ; relative volatility is the standard deviation of the respective variable relative to the standard deviation of the output ; persistence is the first-order serial autocorrelation. For the simulated series from the model, all model moments are obtained by the averages over the 1000 simulations of the model each with 18 (1990-2008) observations.

The figures in Table 3.3 show that the model is able to reproduce some patterns of the business cycles in Senegal. For instance, the model is able to mimic the volatility of sectoral outputs and aggregate output, remittances, consumption and investment with a small margin. The standard deviation of real exchange rate predicted by the model is slightly smaller than the actual one. The volatility of trade balance is higher in the model.

The model is also able to reproduce the comovement pattern observed in the data. This is the case of the procyclical behavior of output in exportable and non-tradable

sectors. The model gives a higher correlation between consumption and investment with aggregate output. The model matches well the correlation of remittances with aggregate output, exportable output, consumption and real exchange rate.

Finally, the model is also able to replicate some persistence properties of business cycles in Senegal.

3.5.5. Dynamic responses

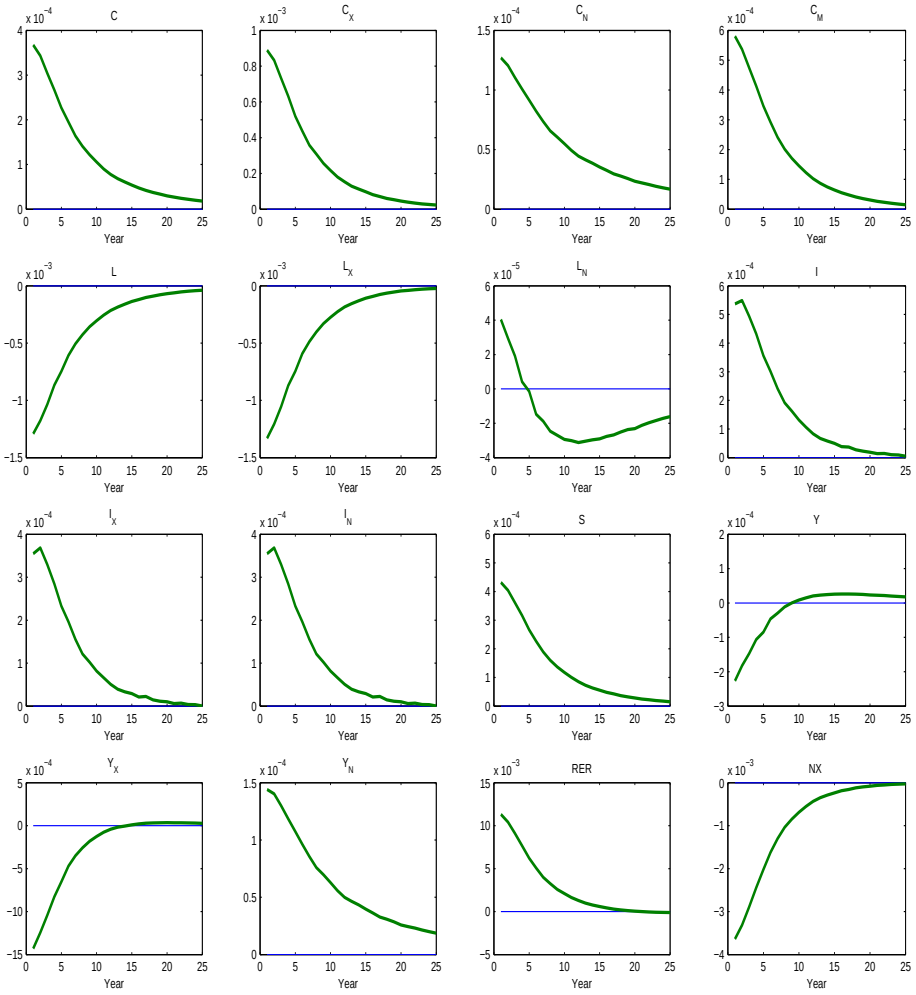
3.5.5.1. Dynamic responses to remittance shocks

This part shows the dynamic effects of remittance shocks by using impulse response analysis. Figure 3.2 displays the model's response to an unanticipated one percentage point transitory increase in the amount of remittances. The positive shock on remittances leads to an increase in household's income, which results in an increase in demand of consumption and a decrease in labor supply. The decline in labor supply is associated with an increase in real wage. The increase in aggregate demand induces an increase in the relative price of non-tradable in terms of exportable because in the short run the supply of non-tradable is less than perfectly elastic. The increase in the relative price of non-tradable represents an appreciation in the real exchange rate.

The real exchange rate appreciation leads to an expansion in non-tradable output and a reallocation of labor from the exportable sector towards the non-tradable one. As a result, exportable sector declines and non-tradable sector expands. This decline in exportable sector is magnified by the decrease in labor supply. As result, the net

exports runs a deficit. Aggregate output declines, since the expansion in non-tradable sector does not compensate the decline in exportable sector.

FIGURE 3.2 – Impulse response to remittance shock



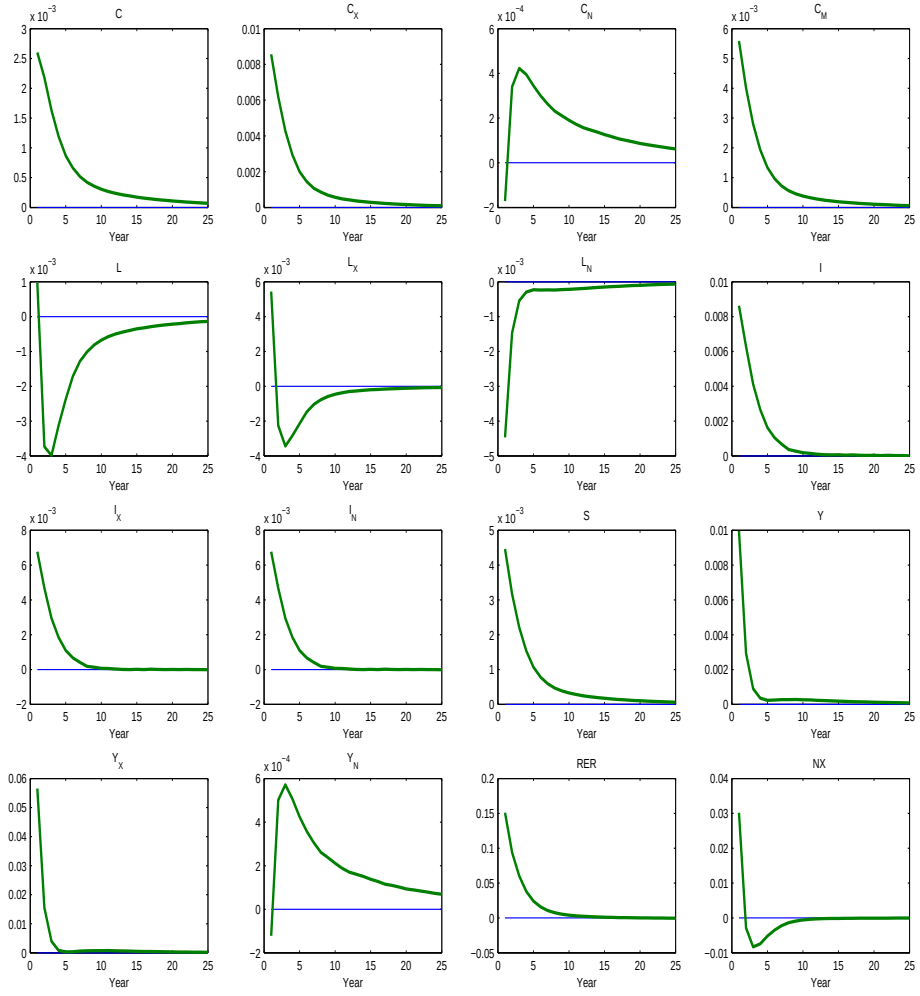
3.5.5.2. Dynamic responses to productivity shock in the exportable good sector

Figure 3.3 displays the model's response to an unanticipated one percentage point transitory increase in productivity shock in the exportable good sector. Following this shock, exportable sector experiences an increase in output and in inputs (labor and imported capital). Aggregate consumption increases as result of increase in total income. Since the real exchange rate appreciates, investment (non-tradable good) and imported intermediate input in the non-tradable sector increases. As result, by substitution effect, labor demand in the non-tradable sector decreases. Overall, the trade balance turns into a surplus.

3.5.5.3. Dynamic responses to productivity shock in the non-tradable good sector

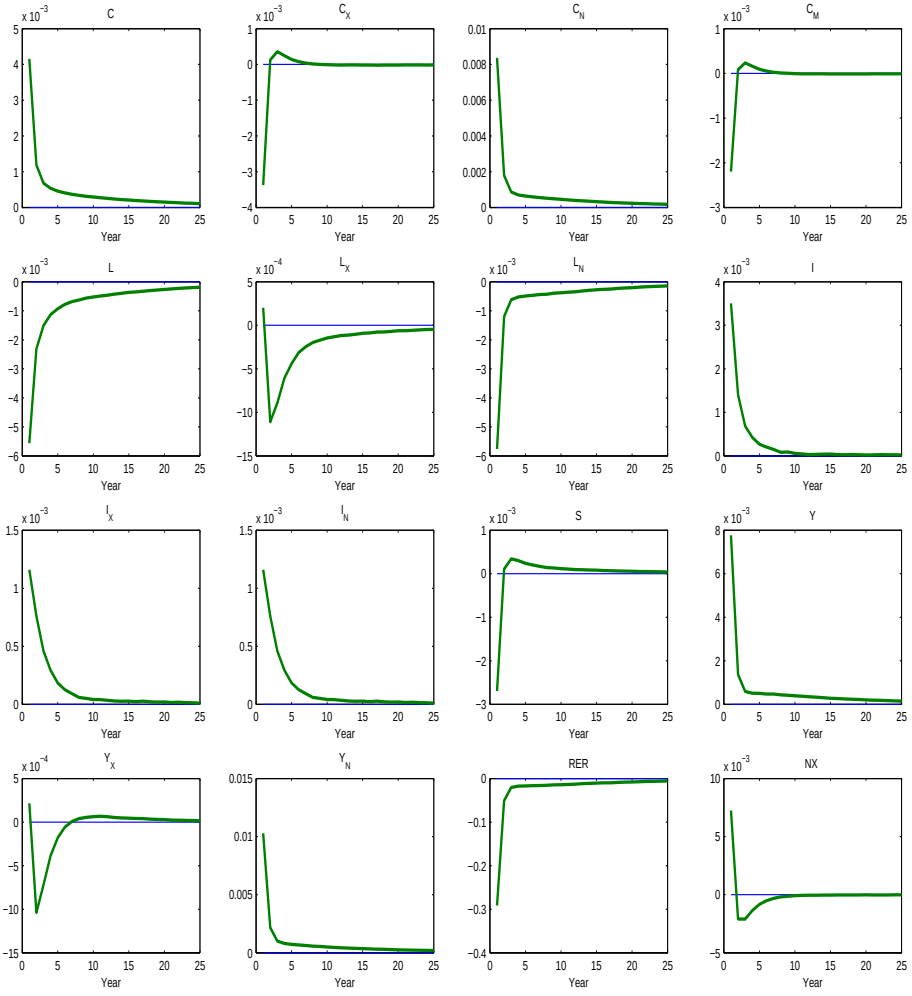
The impulse responses to a one percent increase in the terms of trade are reported in Figure 3.4. Following an increase in productivity shock in the non-tradable good sector, the price of the non-tradable sector decreases followed by an increase in the consumption of non-tradable good and a decrease in the consumption of exportable and imported goods. Real exchange rate depreciates as result of fall in the price of non-tradable good. The depreciation in the real exchange rate induces an increase in imported capital used by the tradable sector and in imported intermediate input used by non-tradable sector. Because of the elasticity of substitution between inputs in the different technologies, labour used in the exportable sector increases, while

FIGURE 3.3 – Impulse response to productivity shock in the exportable good sector



labour used in the non-tradable sector decreases. Overall, aggregate output increases, with a surplus of the net exports.

FIGURE 3.4 – Impulse responses to productivity shock in the non-tradable good sector



3.5.5.4. Dynamic responses to terms of trade shock

Figure 3.5 displays the model's response to an unanticipated one percentage point transitory increase in terms of trade. Notice that, an increase in the terms of trade is equivalent to a rise in the price of exportable good or a decrease in the price

of imported good. Therefore, following this shock, exportable output and inputs used in exportable production increase. The consumption demand of exportable good decreases, while the consumption demand of imported and non-tradable goods increase. The increase in demand for non-tradable good induces an appreciation in the real exchange rate. Since this shock represents a decrease in the price of imported good, imported intermediate input in the non-tradable sector increases. As result, non-tradable output increases, while labor input in non-tradable sector decreases by the substitution effect. Overall, aggregate output and total consumption decrease, and net exports run a surplus.

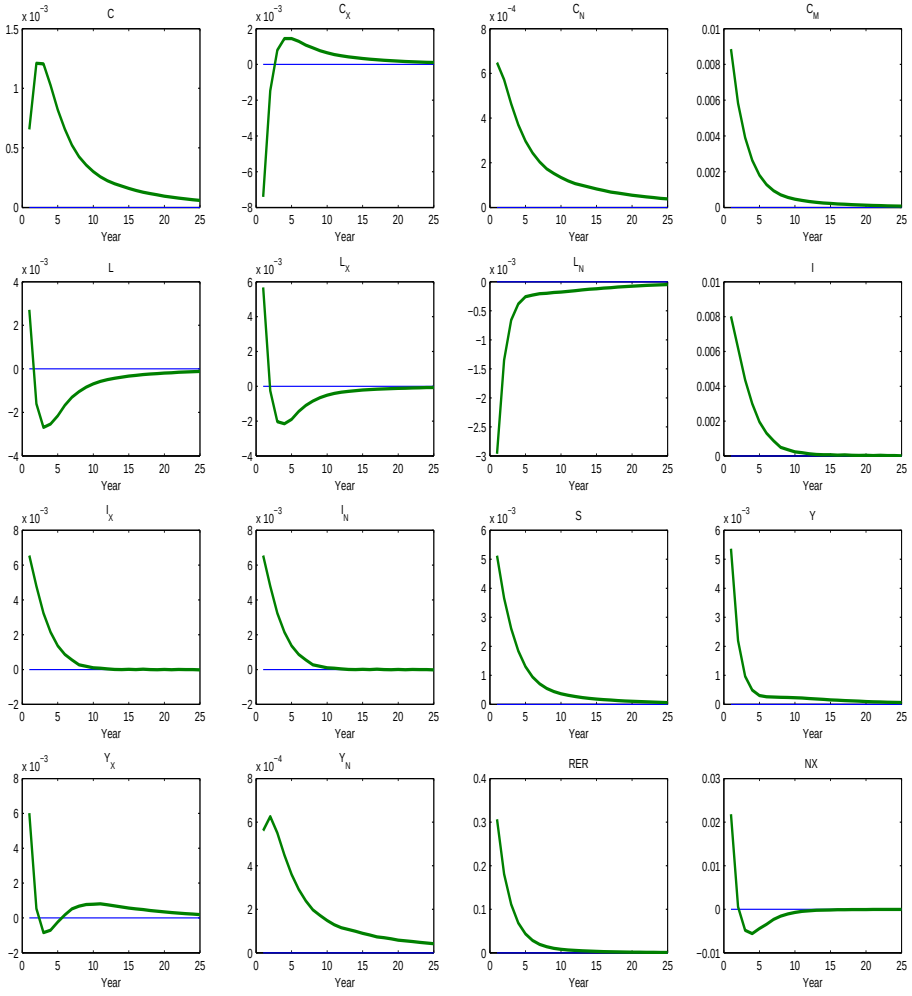
3.5.5.5. Dynamic responses to world interest rate shock

The impulse responses to quarter percentage point increase in the world interest rate are displayed in Figure 3.6. As evidenced (see Kose and Riezman, 2001), this shock has a small impact on consumption, production and labor. However, it induces a large variation in investment accompanied by a surplus in net export.

3.5.5. Variance decomposition analysis

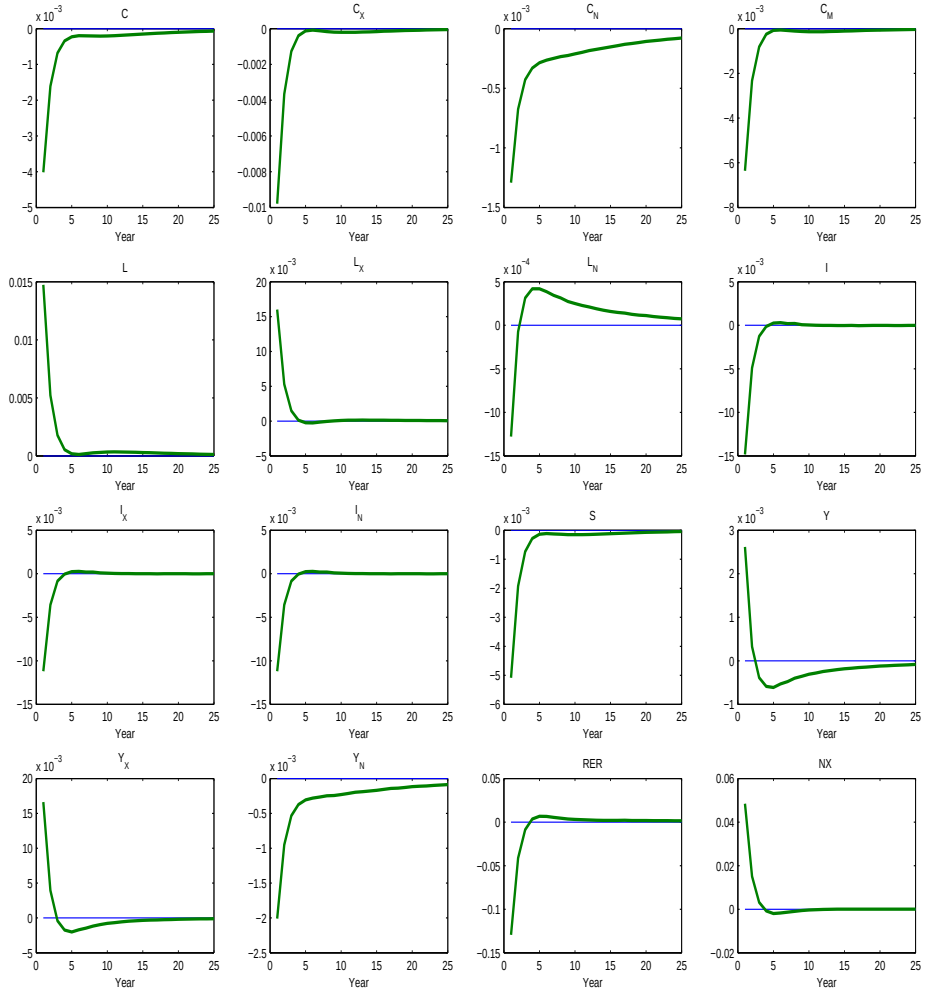
This part presents the variance decomposition analysis (used in the vector auto-regression context) to determine the contribution of shocks in explaining economic fluctuations. In this analysis, a certain information ordering on the shocks must be imposed. The ordering is that, the variables placed first can contemporaneously impact the variables placed latter, while the latters can impact the formers only with

FIGURE 3.5 – Impulse responses to terms of trade shock



a lag. In the case of small open economy, as here, it is natural to place the external shocks (terms of trade, world interest rate and remittances) before domestic shocks. As in the literature, the following information ordering $(TOT_t, i_t^*, \xi_t, A_{X,t}, A_{N,t})$ is

FIGURE 3.6 – Impulse Response to world interest rate shock



used [5].

Table 3.4 displays the results of the variance decompositions. A large fraction of macroeconomic fluctuations is explained by terms trade shocks. They account for

5. Without remittances, this ordering is similar to that used in the previous studies by Kose and Riezman (2001) and Kose (2002)

roughly 61% of the variation in aggregate output of Senegal. World interest rate explains about only 2% of variation in aggregate output. Exportable productivity shocks explain about 27% of variation in aggregate output, while the contribution of non-tradable productivity to fluctuation in aggregate output is insignificant. The new result in this model is the contribution of remittance shocks to business cycles. Remittance shocks are able to explain about 10% of variation in aggregate output and consumption. About 20% of fluctuations in real exchange rate are explained by remittance shocks.

The results from this study are in line with previous studies that do not take into account remittance shocks (Mendoza, 1995 ; Kose and Riezman, 2001 and Kose, 2002). These previous studies show that terms of trade shocks are the most important factor that drive output fluctuations in developing countries, while world interest rate shocks are not substantial in explaining output fluctuations.

TABLE 3.4 – Variance decomposition

Variables	Shocks				
	Exportable Productivity	Non-tradable Productivity	World Interest Rate	Terms of trade	Remittances
Y	26.93	0.04	2.41	61.17	9.56
Y_X	35.68	0.19	8.95	46.90	8.28
Y_N	8.35	38.45	1.49	45.51	8.14
C	18.40	0.38	5.17	65.10	10.15
I	26.07	0.07	2.17	61.54	10.15
RER	20.68	7.98	2.03	49.77	19.53
L	16.56	2.26	2.11	65.97	13.10
NX	16.85	1.20	40.34	32.64	8.97

3.5.5. Sensitivity analysis

This section provides sensitivity analysis about the mechanics of the model. The first analysis is the individual impact of remittance shocks. Table 3.3 presents the

results of simulation when only remittance shocks are present. The model is not able to match the volatility of aggregate output and its components. Nevertheless, it is able to capture a significant fraction of variation in aggregate output, its components, and real exchange rate.

The sensitivity of the results to changes in some parameters of the model is also investigated. The following parameters are considered : the elasticity of substitution in intermediate and capital goods, u, the risk aversion parameter, σ, the share of land in exportable sector, $1-\alpha_1-\alpha_2$. The results are presented in Table 3.5. When the elasticity of substitution in intermediate and capital goods (u) increases, the volatility of the trade balance rises and the volatility of other variables increase. As argued by Kose and Riezman (2001), this result can be explained by the following intuition : the domestic economy uses less often intermediate inputs, then faces less variation in the trade balance. The volatility of other variables slightly increases, since the representative household substitutes domestic capital into imported intermediate inputs more often. An increase in the risk aversion parameter (σ) also decreases the variation in the trade balance. A decrease in the share of land ($1-\alpha_1-\alpha_2$) makes the model to magnify the fluctuations of macroeconomic variables. As mentioned by Kose and Riezman (2001), using inelastically supplied land allows to reduce factor substitution effects in the exportable sector, then allows the model to have realistic fluctuations.

The sensitivity results of the variance decomposition to changes in stochastic process of remittance shocks are presented in Table 3.6. An increase in the ratio

TABLE 3.5 – Business cycle properties : Sensitivity analysis

	Y	Y_X	Y_N	C	I	REM	RER	NX
Volatility								
Benchmark Model	2.08	5.10	4.38	6.74	5.64	7.98	2.07	2.18
u rises by 20%	2.88	5.56	4.86	7.01	5.80	8.22	2.21	1.56
σ rises by 20%	2.25	5.38	4.68	6.87	5.76	8.20	2.05	1.11
$(1-\alpha_1-\alpha_2)$ falls by 20%	3.11	5.86	8.14	6.55	8.12	9.01	2.97	3.01

of remittances to GDP leads to an increase in the contribution of remittances to business cycles. When the volatility of remittance shocks increases the contribution of remittances to business cycles increases. While changes in the persistence of remittance shocks have slight impact on the variance decomposition.

TABLE 3.6 – Sensitivity analysis of variance decomposition

Variables	Shocks				
	Exportable Productivity	Non-tradable Productivity	World Interest Rate	Terms of trade	Remittances
Benchmark					
Y	26.93	0.04	2.41	61.17	9.56
Y_X	35.68	0.19	8.95	46.90	8.28
Y_N	8.35	38.45	1.49	45.51	8.14
C	18.40	0.38	5.17	65.10	10.15
I	26.07	0.07	2.17	61.54	10.15
RER	20.68	7.98	2.03	49.77	19.53
L	16.56	2.26	2.11	65.97	13.10
NX	16.85	1.20	40.34	32.64	8.97
Remittances/GDP= 20% ↑					
Y	24.68	0.04	2.26	52.26	18.80
Y_X	33.46	0.17	6.15	40.41	20.01
Y_N	6.20	36.36	1.01	39.42	17.01
C	13.20	0.21	3.16	62.31	21.12
I	16.64	0.04	1.67	58.51	23.14
RER	18.88	7.28	0.99	37.78	20.02
L	14.56	1.77	1.62	64.00	18.05
NX	10.81	0.56	44.32	28.70	15.51
Volatility of remittance shocks rises by 20%					
Y	23.80	0.03	1.01	59.86	15.30
Y_X	30.51	0.16	8.71	45.81	14.81
Y_N	6.93	34.36	1.09	44.18	13.44
C	15.78	0.21	3.71	64.15	16.15
I	13.48	0.03	1.87	57.50	27.12
RER	21.88	7.37	0.84	46.79	25.02
L	14.69	1.65	1.43	63.05	19.18
NX	10.95	0.49	44.31	30.62	13.63
Persistence of remittance shocks rises by 20%					
Y	25.28	0.03	2.20	60.13	11.40
Y_X	35.44	0.16	8.73	45.39	10.26
Y_N	8.12	37.34	1.46	45.46	9.62
C	18.69	0.25	4.73	65.27	11.04
I	16.09	0.03	2.11	60.48	12.77
RER	19.87	8.36	1.83	47.77	22.07
L	16.01	2.27	2.10	65.90	13.57
NX	11.78	0.52	45.34	30.68	11.65

A devaluation occurred in Senegal in 1994. To examine the results robustness to this devaluation, the model is simulated using Senegal data after 1994. The parameters of shocks after the devaluation are the following :

$$\mathbf{\Pi} = \begin{bmatrix} 0.85 & 0 & 0 & 0 & 0 \\ 0 & 0.84 & 0 & 0 & 0 \\ 0 & 0 & 0.71 & 0 & 0 \\ 0 & 0 & 0 & 0.89 & 0 \\ 0 & 0 & 0 & 0 & 0.92 \end{bmatrix}$$

$$\mathbf{\Sigma} = \begin{bmatrix} 0.021^2 & 0 & 0 & 0 & 0 \\ -0.281 & 0.012^2 & 0 & 0 & 0 \\ 0.071 & -0.007 & 0.010^2 & 0 & 0 \\ -0.054 & 0.141 & 0.184 & 0.0.03^2 & 0 \\ 0.531 & -0.030 & 0.051 & -0.031 & 0.18^2 \end{bmatrix}$$

TABLE 3.7 – Business cycle properties : sensitivity to devaluation in 1994

	Y	Y_X	Y_N	C	I	REM	RER	L	NX
Volatility									
Data	1.34	3.73	1.10	1.86	7.05	10.77	10.08	2.74	1.37
Model	2.11	5.71	4.31	6.98	5.67	7.95	2.01	3.47	2.15
Model without Remit. shocks	1.91	4.44	1.18	1.97	5.37	0	1.57	2.87	1.32
Model with Remit ; shocks only	0.47	0.67	0.37	0.44	0.71	8.97	2.07	0.65	0.07
Correlation with GDP									
Data	1	0.84	0.44	0.10	0.23	0.17	0.55	0.78	-0.12
Model	1	0.96	0.66	0.91	2.71	0.03	0.27	0.71	-0.20
Correlation with Remit.									
Data	0.17	0.37	0.36	0.13	-0.43	1	0.25	-0.27	-0.06
Model	0.54	-0.47	0.18	0.11	-0.17	1	0.476	-0.37	-0.32
Persistence									
Data	0.51	0.41	0.24	0.76	0.47	0.67	0.63	0.47	0.94
Model	0.86	0.91	0.77	0.87	0.70	0.83	0.84	0.74	0.57

Notes : Both the artificial series simulated by the model and the actual data are logged (except current account) and detrended by HP(100) filter. For the actual data, volatility is the percentage deviation from the HP trend ; relative volatility is the standard deviation of the respective variable relative to the standard deviation of the output ; persistence is the first-order serial autocorrelation. For the simulated series from the model, all model moments are obtained by the averages over the 1000 simulations of the model each with 14 (1995-2008) observations.

Table 3.7 presents the business cycle properties after the devaluation. As before,

TABLE 3.8 – Variance decomposition : sensitivity analysis to devaluation

Variables	Shocks				
	Exportable Productivity	non-tradable Productivity	World Interest Rate	Terms of trade	Remittances
Y	26.48	0.03	2.37	59.11	12.01
Y_X	35.84	0.22	8.87	45.81	9.25
Y_N	7.07	37.87	1.17	44.78	9.11
C	19.29	0.80	4.87	63.17	11.87
I	26.07	0.07	2.17	61.54	10.15
RER	21.14	6.49	2.03	48.79	21.55
L	20.47	2.18	2.07	60.18	15.10
NX	10.23	2.17	39.18	37.25	11.17

the model is able to replicate the business cycle of Senegal after the devaluation.

Table 3.8 presents the variance decomposition with the model calibrated on data after the devaluation. After the devaluation, the contribution of remittances to business cycle increases slightly. This result can be explain by the fact that the average level of remittances after the devaluation is greater than on all of the period of analysis (6.52% of GDP v.s. 5.01% of GDP) .

3.6. Conclusion

This chapter has examined the contribution of remittances to macroeconomic fluctuations in Senegal, using a dynamic, stochastic, three-good model. The model is able to replicate some key features of business cycles in Senegal.

The results from this study are in line of those from previous studies on business cycles in developing countries (Mendoza, 1995 ; Kose and Riezman, 2001 and Kose, 2002). Particularly, as in previous studies, a substantial fraction of cyclical fluctuations in Senegal is explained by terms of trade shocks (about 60%). Exportable productivity shocks explain important share in the fluctuations of Senegal's

economy (about 27%), while non-tradable productivity shocks have a insignificant contribution of these fluctuations. As in the previous studies, the contribution of world interest rate shocks in explaining Senegal's fluctuations is insignificant.

The departure from these previous studies is the consideration of remittance shocks. The results suggest that remittance shocks have a significant role in driving macroeconomic fluctuations in Senegal. In particular, about 10% of the fluctuations in aggregate output and consumption of Senegal is explained by remittance shocks. Moreover, remittance shocks explain about 20% of the fluctuations in real exchange rate of Senegal.

The results from this chapter underline the fact that policy makers in remittances recipient countries have to consider remittance shocks when they seek to stabilize their economies.

This model evaluates the contribution of remittances to business cycles, but has not considered the issues related to monetary policy. Extending the model along these dimensions are important steps for future research. The next chapter continues in this line by examining the effect of remittances in a monetary framework. Particularly, the next chapter theoretically analyzes the response of real exchange rate in fixed and flexible exchange rate regimes. Moreover, an empirical study is conducted on Franc CFA Zone countries that are in fixed exchange rate regime.

Chapitre 4

Remittances and real exchange rate : Evidence from CFA zone

4.1. Introduction

Monetary authorities in remittances recipient countries seek to know how to respond best to remittances inflows, while researchers examine the beneficial or adverse impact of these inflows. As mentioned in Chapter 1, some studies (Adams and Page, 2005 ; Aggarwal et al., 2006 ; Acosta et al., 2008 ; Giuliano and Ruiz-Arranz, 2009) have provided evidence that remittances contribute to economic development (lower poverty, higher financial development and higher growth rates). Other studies (Amuedo-Dorantes and Pozo, 2004 ; López et al., 2007) have pointed out that increase in remittances leads to Dutch disease effect in recipient economies, i.e an appreciation in real exchange rate accompanied with a resource allocation from tra-

dable sector towards nontradable sector.

An issue arrives when one considers the relationship between remittances and real exchange rate. The effect of remittance shocks on real exchange rate is different depending on the exchange rate regimes. As mentioned by Ball et al. (2008), exchange rate regimes matter because remittances are sent in foreign currency and must be converted - at least in part- into the domestic currency in order to be spent. Thus, remittances would increase money demand. It is well know that the impact of the increase in money demand depends on the exchange rate regimes. Under a flexible exchange rate regime, an increase in money demand, by raising the value of the domestic currency, leads to an increase in domestic interest rate through interest rate parity condition (perfect international capital mobility). In contrast, under a fixed exchange rate regime, an increase in money demand, by expanding international reserves, leads to an increase in the nominal money supply rise while the domestic interest rate remains unchanged. Hence, an increase in remittances by increasing money demand leads to real exchange rate appreciation which magnitude depends on exchange rate regimes.

The aim of this chapter is to examine the effect of the remittances on real exchange rate using the panel data of CFA zone countries. Since CFA zone is a currency union, the sample of CFA zone does not suffer from estimation issue linked to the exchange rate regime. The study includes ten CFA zone countries selected for the annual data availability. The annual data cover the period 1980-2007.

Before conducting the empirical estimation, this chapter develops a simple small

open economy model to examine the intuition that the magnitude of remittances impact on real exchange rate would depend on exchange rate regime. In this model, I also examine the impact of foreign aid (foreign public gifts) on real exchange rate. The theoretical model shows that, in the long-run, the effect of remittances on real exchange rate is the same whatever the exchange rate regime. But in the short-run, the response of real exchange rate to an increase in remittances depends on exchange rate regime. In response to an increase in remittances, the real exchange rate falls (real exchange appreciation) with an initial response more pronounced under a flexible exchange rates than under a fixed exchange rates. The theoretical model also suggests that, if remittances inflows are sterilized by monetary authorities (as it is potentially the case of CFA zone), the response of real exchange rate to remittance shocks would be smaller. Finally, the theoretical model shows evidence that foreign aid would lead to an appreciation in real exchange rate (in both the long and short run), if it is used to finance public provision in nontradable good. On the contrary, foreign aid has a mitigated effect on real exchange rate (in both the long and short run), if it is allocated to productive government spending.

The empirical results suggest that an increase in remittances leads to an appreciation in real exchange rate in CFA Franc zone countries, while changes in other capital inflows (foreign aid, foreign direct investment (FDI)) do not affect the real exchange rate.

The rest of the chapter is organized as follows. Section 2 provides a brief survey of the literature. Section 3 describes the theoretical model that shows that the effect of

remittance inflows on real exchange rate depends on exchange rate regimes. Section 4 presents the empirical analysis using data of CFA Franc zone countries. Finally, Section 5 concludes.

4.2. Related literature

Some previous studies have examined the effect of remittances on real exchange rate. Amuedo-Dorantes and Pozo (2004) find empirical evidence of the real exchange rate appreciation, using annual data from 1979 to 1998 for 13 Latin American and Caribbean countries. The authors do not control for exchange rate regimes, while some countries in the sample considered had both fixed and flexible exchange rates regimes during the period studied.

Bourdet and Falck (2006) also examine the impact of remittances on real exchange rate by considering Cape Verde data from 1975 to 2005. Once more, they do not consider exchange rate regimes explicitly while during the period considered Cape Verde did not have one regime.

López et al. (2007) also examine the influence of remittances on real exchange rates by using a static computable general equilibrium model. They predict that remittances lead to a real exchange rate appreciation. By analyzing 13 years of data across 20 countries, they find empirical evidence showing the appreciation impact of remittances. As Amuedo-Dorantes and Pozo (2004) and Bourdet and Falck (2006), they do not take into account exchange rate regimes, while, 90% of the 20 countries studied have more than one regime (Ball et al., 2008).

Lartey (2007) investigates whether capital inflows cause an appreciation in real exchange rate in a sample of Sub-Saharan Africa for the period 1980-2000. The sample includes some countries of CFA Franc zone that are Cameroon, Central African Republic, Côte d'Ivoire, Equatorial Guinea, Gabon and Togo ; the Non-CFA countries are Burundi, The Gambia, Ghana, Lesotho, Malawi, Nigeria, Sierra Leone, South Africa, Uganda and Zambia. The analysis (not concerning remittances) shows that an increase in official aid causes a real exchange rate appreciation, the magnitude being greater compared to that associated with foreign direct investment.

Acosta et al. (2009), using data for El Salvador and employing Bayesian techniques, estimate a two-sector dynamic stochastic general equilibrium without money. They find that remittances lead to a Dutch disease effect, but improve the welfare of households by helping to smooth income flows and by increasing consumption and leisure level.

Ouattara and Strobl (2008), using data on CFA countries over the period 1980-2000, find that foreign aid inflows are associated with the appreciation of the real exchange rate in the CFA countries.

A contribution by Acosta et al. (2008), closely related to my study, examines the role of exchange rate regimes in impacting the Dutch Disease effect induced by remittance inflows. This study (including the 10 CFA countries considered in our analysis) indicates that the Dutch Disease effect caused by remittance inflows operate more strongly under fixed nominal exchange rate regimes. Contrary to this study, here only CFA countries are considered. Since CFA countries are in currency union, the issue

related to exchange rate regimes does matter by focusing solely on these countries. Moreover, from the econometric point of view, these countries being (economically) relatively similar, the assumptions about the homogeneity of parameter estimates and the data generating process are more likely to hold (Ouattara and Strobl, 2008). Finally contrary to the previous studies, this paper compares the Dutch disease effect caused by remittances in CFA Franc zone countries to that of other capital inflows (foreign aid, foreign direct investment) received in CFA Franc zone countries.

The recent paper by Ball et al. (2008) investigates the impact of remittances on inflation rate by accounting for the role of exchange rate regime. The authors first build a theoretical model that shows that, under a fixed regime, remittances temporarily rise inflation by increasing domestic money supply, but under a flexible regime, remittances decrease inflation leaving money supply unchanged. This theoretical result is corroborated by the empirical evidence using yearly and quarterly data for 7 Latin American countries. The theoretical model used in this chapter is similar to that used in Ball et al. (2008). However, contrary to Ball et al. (2008), the focus is on the real exchange rate. Moreover, this chapter considers not only remittances but also foreign aid.

4.3. A small open monetary economy with remittances

We consider a small open economy [1] that is inhabited by a large number of identical, infinitely-lived consumers, who are endowed with perfect foresight. The

1. This model is inspired by Chapter 8 of Carlos A Végh's manuscript under preparation for his forthcoming book, current version (2007).

economy is assumed to be perfectly integrated with the rest of the world in terms of goods and capital. In the economy, there are two physical goods (one tradable and the other nontradable, both nonstorable). The model developed here is similar to that used in Ball et al. (2008).

4.3.3. Household

The representative household has an utility function that is assumed to be separable in all its components and over time, as in Ball et al. (2008).

$$U(C_t^T, C_t^N, Z_t) = \int_0^\infty e^{-\rho t} \left[\gamma log(C_t^T) + (1-\gamma) log(C_t^N) + \psi log(z_t\right] dt \tag{4.1}$$

where C_t^T and C_t^N denote consumption of tradable and nontradable goods, respectively, and $z_t = M_t/P_t$ denotes the real money balances in terms of the price index P_t given by :

$$P_t = (P_t^T)^\gamma (P_t^N)^{1-\gamma} \tag{4.2}$$

Following Vegh (2007), money balances enter directly in the utility function to capture the liquidity services provided by money. Therefore, nominal balances is deflated by a price index because the consumer consumes both goods.

The law of one price is assumed to be held for the tradable good. For simplicity, tradable good is used as numeraire, hence,

$$P_t^T = E_t \tag{4.3}$$

Household can hold internationally tradable assets yielding the constant world interest rate r, earns income from the sale of tradable good Y_t^T, and non-tradable good Y_t^T, receives transfers from the government T_t and receives exogenous remittances REM from abroad. Let $A_t \equiv m_t + b_t$ represent real financial assets in term of tradable goods, where m_t is real money balances in terms of tradable goods and b_t denotes net foreign bonds in terms of tradable goods held by consumer. The consumer's budget constraint in terms of tradable goods can be written as follow :

$$\dot{a}_t = ra_t + Y_t^T + \frac{Y_t^N}{e_t} + T_t + REM - C_t^T - \frac{C_t^N}{e_t} - i_t \frac{z_t}{(e_t)^{1-\gamma}} \tag{4.4}$$

where $e_t (\equiv P_t^T/P_t^N)$ is the real exchange rate and i_t is the nominal interest rate. Since tradable goods are used as the numeraire, the opportunity cost of holding real money balances -given by $i_t(M_t/P_t^T)$- can be expressed as $i_t(M/P_t)(P_t/P_t^T)$ which, taking into account (4.2) and the definition of the real exchange rate, equals $i_t Z_t/(e_t)^{1-\gamma}$.

Integrating (4.4) and imposing the appropriate transversality condition gives the following condition :

$$a_0 + \int_0^\infty e^{-\rho t}(Y_t^T + e_t Y_t^N + T_t + REM)dt = \int_0^\infty e^{-\rho t}(C_t^T + e_t C_t^N + i_t \frac{z_t}{(e_t)^{1-\gamma}})dt \tag{4.5}$$

The program of the representative household is to choose C^T, C^N, and z in order to maximize (4.1) subject to the intertemporal constraint (4.5). Assuming $\beta = r$ and letting λ denote the Lagrangian multiplier, the first-order conditions are given by :

$$\frac{\gamma}{C_t^T} = \lambda \tag{4.6}$$

$$\frac{1-\gamma}{C_t^N} = \frac{\lambda}{e_t} \tag{4.7}$$

$$\frac{\psi}{z_t} = \frac{\lambda i_t}{(e_t)^{1-\gamma}} \tag{4.8}$$

Equations (4.6) and (4.7) are the optimality condition for consumption of tradable and nontradable goods, respectively. Equation (4.8) is the optimality condition for real money balances.

Combining (4.6) and (4.7) gives the following condition :

$$\frac{\gamma}{1-\gamma}\frac{C_t^N}{C_t^T} = e_t \tag{4.9}$$

This condition says that the marginal rate of substitution between tradable and nontradable goods equals the relative price.

For further reference, combining (4.6) and (4.8) gives the demand of real money balances in terms of tradable goods :

$$m_t = \frac{\psi}{\gamma}\frac{C_t^T}{i_t} \tag{4.10}$$

Finally, notice that $z_t(e_t)^\gamma = M_t/P_t^N$ and the money demand in terms of nontradable goods ($n_t \equiv M_t/P_t^N$) allows to rewrite

$$n_t = \frac{C_t^N}{(1-\gamma)i_t} \tag{4.11}$$

Defining money demand in terms of nontradable good will become useful later.

4.3.3. Supply side

The production in the two sector uses labor as a single input. Labor is supplied inelastically and there is perfect labor mobility across the two sectors. The total labor endowment is set to unity, $L_t^T + L_t^N = 1$, where L_t^T and L_t^N represents employment in the tradable and nontradable sector, respectively. The production functions are given by :

$$Y_t^T = A_t^T (L_t^T)^\alpha \quad 0 < \alpha < 1 \tag{4.12}$$

and

$$Y_t^N = A_t^N (L_t^N)^\beta \quad 0 < \beta < 1 \tag{4.13}$$

where A_t^T and A_t^N represent technology factors.

The optimal reallocation of labor across the two sectors is given by :

$$\alpha A_t^T (L_t^T)^{\alpha-1} = \frac{1}{e_t} \beta A_t^N (L_t^N)^{\beta-1} \tag{4.14}$$

Equation (4.14) shows that the marginal productivity of labor is equal across the two sectors.

As mentioned above, the prices of tradable good evolve according to the law of one price. On the contrary, the prices of nontradable are assumed to be sticky. Formally, as in Vegh (2007), sticky prices in the nontradable sector are introduced via Calvo's (1983) staggered prices formulation. This formulation is that the rate of change in inflation rate is negatively related to excess aggregate demand :

$$\dot{\pi}_t = -\theta(C_t^N - \bar{Y}^N), \quad \theta > 0 \tag{4.15}$$

where $\bar{Y}^N$ is the steady-state level of output in nontradable sector. In this formulation, the nontradable price level is predetermined at each instant in time, but the nontradable inflation rate is fully flexible because it is a forward-looking variable. Therefore, in the short-run, output in nontradable sector is assumed to be demand-determined so that the nontradable good market equilibrium is achieved at all times.

4.3.3. Government

As in Vegh (2007), the government in the model is composed by the fiscal authority and the monetary authority (i.e., the central bank). Let H_t^* denote the amount of net foreign bonds in terms of foreign currency held by the government and $H_t(\equiv E_t H_t^*)$ represent these bonds in terms of domestic currency. Hence, the government's budget constraint in terms of tradable goods writes as follow :

$$\dot{h}_t = rh_t + \dot{m}_t + \varepsilon_t m_t - T_t \tag{4.16}$$

where $h_t(\equiv H_t/P_t^T)$ is the government's bonds in terms of tradable good, $\varepsilon_t(\equiv \dot{E}_t/E_t)$ is the depreciation rate of domestic currency. The corresponding intertemporal constraint is :

$$h_0 + \int_0^\infty e^{-rt}(\dot{m}_t + \varepsilon_t m_t)dt = \int_0^\infty e^{-rt} T_t dt \tag{4.17}$$

4.3.3. Equilibrium conditions

As in Vegh (2007), the model assumes the perfect international capital mobility. This assumption implies that interest rate parity holds :

$$i_t = r + \varepsilon_t \tag{4.18}$$

Market clearing in the nontradable sector requires that :

$$C_t^N = Y_t^N \tag{4.19}$$

As mentioned above, output of nontradable goods is demand-determined, so equilibrium in the nontradable goods market holds by construction.

By definition, $e_t = P_t^T/P_t^N = E_t/P_t^N$, hence,

$$\frac{\dot{e}_t}{e_t} = \varepsilon_t - \pi_t \tag{4.20}$$

Using equilibrium in the nontradable sector and combining the consumers' budget constraint (4.4) with that of the government's (4.16) give

$$\dot{f}_t = r f_t + Y_t^T + REM - C_t^T \tag{4.21}$$

where $f \equiv b + h$ is the economy's total net foreign assets. The corresponding intertemporal condition is :

$$f_0 + \int_0^\infty e^{-rt}(Y_t^T + REM)dt = \int_0^\infty e^{-rt} C_t^T dt \tag{4.22}$$

4.3.3. Dynamic system and effects of an increase in remittances

From first-order condition (4.6), it follows that c_t^T will be constant over time. From the resource constraint (4.22), this constant value given by the steady state level is :

$$\bar{C}^T = r f_0 + \bar{Y}^T + REM \tag{4.23}$$

where $\bar{Y}^T$ is the steady state level of Y_t. Equation (4.23) implies that the constant level of tradable good consumption is given by the flow of returns from initial asset holdings, the constant flow of remittances and tradable good production.

4.3.3.1. Under predetermined exchange rates (fixed exchange rates - the case of Franc CFA Zone)

The dynamics of model are first analyzed in the case of the predetermined exchange rate that is the case of Franc CFA Zone. Under a predetermined exchange rate regime, the initial level of the nominal exchange rate, E, and its growth rate, $\bar{\varepsilon}$, are set by the monetary authorities. The fixed exchange rate regime is just a particular case of the predetermined exchange rates regime in which $\bar{\varepsilon} = 0$.

Under a predetermined exchange rate regime, the central bank maintains the predetermined exchange rate by adjusting international reserve levels, and, hence, the nominal money supply is endogenous.

First, notice that, as in the flexible exchange rates case, consumption of tradable good will be given by equation (4.21). From the interest rate parity condition (4.18), the nominal interest rate will be constant and given by $\bar{i} = r + \bar{\varepsilon}$.

In order to solve for the model, we have a different dynamic system from the one used below for flexible exchange rates for the following reasons. The variable μ is an endogenous variable and the real money balances in terms of nontradable goods

(n) are no longer a predetermined variable under predetermined exchange rates because the nominal money supply is an endogenously determined in a predetermined exchange regime. Hence, it would be reasonable to avoid to set a dynamic system with two jumping variables, otherwise it would be harder to solve. As noticed by Vegh (2007), the obvious candidate is the real exchange rate, e. Since $e = E/P^N$, the real exchange rate will be a predetermined variable under sticky prices.

Hence, under a predetermined exchange rate regime, the economy's behavior is driven by equation (4.20) and the following equation :

$$\dot{\pi}_t = \theta \left(\bar{Y}^N - \frac{1-\gamma}{\gamma} e_t \bar{C}^T \right) \tag{4.24}$$

The steady-state level of the system is given by

$$\pi_{ss} = \bar{\varepsilon} \tag{4.25}$$

$$e_{ss} = \frac{\gamma}{1-\gamma} \frac{\bar{Y}^N}{\bar{C}^T} \tag{4.26}$$

The linearization of the system around the steady-state gives

$$\begin{pmatrix} \dot{e}_t \\ \\ \dot{\pi}_t \end{pmatrix} = \begin{pmatrix} 0 & -e_{ss} \\ \\ -\theta \frac{1-\gamma}{\gamma} \bar{C}^T & 0 \end{pmatrix} \begin{pmatrix} e_t - e_{ss} \\ \\ \pi_t - \bar{\mu} \end{pmatrix}$$

This system has one positive and one negative root and thus exhibits saddle-path stability.

The impact of increase in remittances on the model dynamic under a predeter-

mined exchange rates is summarized in the following result.

Proposition 1 *: Under a predetermined exchange rates regime, an increase in remittances leads to an increase in growth of nominal money supply, an increase in inflation and an appreciation in real exchange rate.*

Figure 4.1-a shows the phase diagram representation of model dynamic under a fixed exchange rate after an increase in remittances. Suppose that, just before $t = 0$, the economy is in the initial stationary equilibrium corresponding to point E_0 in Figure 4.1-a. At time 0, there is an unanticipated and permanent increase in remittances REM.

The initial impact of an increase in remittances is a rise in the real money demand. To maintain the devaluation rate ($\varepsilon = \bar{\varepsilon}$), the central bank reacts by increasing the nominal supply to offset the increase in money demand. Since the real exchange rate, e, is predetermined, the inflation jumps up to point E' in Figure 4.1-a. This induces a dynamics in nontradable prices and real exchange rate to necessary reach the new steady state (point E_1 in Figure 4.1-a). During the transition, the real exchange rate and inflation fall continuously. A fall in the real exchange rate, e, represents an appreciation in the real exchange rate. The inflation in the new steady-state is the same as the initial steady-state, but, the real exchange rate is lower in the new steady-state than in the initial one. The effect of permanent increase in remittances on steady state variables is showed in the Appendix.

4.3.3.2. Under flexible exchange rates

Under flexible exchange rates, given the initial level of money, M_0, the central bank sets the rate of growth of nominal money supply, μ, to $\bar{\mu}$. In this case, equilibrium in money market is achieved by allowing the nominal exchange rate to adjust endogenously.

By definition, $m = M/E$. Hence,

$$\frac{\dot{m}_t}{m_t} = \bar{\mu} - \varepsilon_t \tag{4.27}$$

Combining the interest parity condition (4.18) with (4.10) and (4.23) gives :

$$\varepsilon_t = \frac{\bar{C}^T}{\gamma m_t} - r \tag{4.28}$$

Combining (4.28) with (4.22) gives the following equation

$$\dot{m}_t = (r + \bar{\mu})m_t - \frac{\bar{C}^T}{\gamma} \tag{4.29}$$

Since $\frac{\partial \dot{m}_t}{\partial m_t} = r + \bar{\mu} > 0$, the differential equation (4.29) is unstable. Therefore, along a perfect foresight path, m will be constant and this constant value is given by

$$\bar{m} = \frac{\bar{C}^T}{\gamma(r + \bar{\mu})} \tag{4.30}$$

Since m is constant, it follows that ε will also be constant and given by $\bar{\varepsilon} = \bar{\mu}$.

As result, the nominal interest rate will be constant to $\bar{i} = r + \bar{\mu}$.

To solve for the rest of the system, the system dynamic can be set up in real money balances in terms of nontradable goods, $n(\equiv M/P^N)$, and in nontradable inflation rate π. Under the flexible exchange rates, the variable n is predetermined, since M is exogenous (i.e. controlled by the central bank) and the prices of nontradable goods are sticky. Nontradable inflation rate π remains a control variable, under the flexible exchange rates. Using the definition of n, it follows that

$$\dot{n}_t = n_t(\bar{\mu} - \pi_t) \tag{4.31}$$

Using (4.15) and (4.19), the second dynamic equation is given by :

$$\dot{\pi}_t = \theta(\bar{Y}^N - C_t^N), \text{ where } \bar{Y}^N = Y^N(\bar{L}^N) = A^N(\bar{L}^N)^\beta \tag{4.32}$$

Hence, inflation will be rising if consumption of nontradable good is below its steady-state level and vice versa.

Noting that $e_t = n_t/m_t$, equation (4.32) can be rewritten :

$$\dot{\pi}_t = \theta(\bar{Y}^N - \frac{1-\gamma}{\psi}\bar{i}n_t) \tag{4.33}$$

Equations (4.31) and (4.33) constitute the dynamic system in n and π . The steady-state of this dynamic system is characterized by setting $\dot{n}_t = \dot{\pi}_t = 0$, which gives :

$$\pi_{ss} = \bar{\mu} \tag{4.34}$$

$$n_{ss} = \frac{\psi \bar{Y}^N}{(1-\gamma)\bar{i}} = \frac{\psi A^N (\bar{L}^N)^\beta}{(1-\gamma)\bar{i}} \tag{4.35}$$

Equation (4.35) says that changes in steady state employment allocation affect the steady state level of nontradable good production.

The linearization around the steady-state gives :

$$\begin{pmatrix} \dot{n}_t \\ \\ \dot{\pi}_t \end{pmatrix} = \begin{pmatrix} 0 & -n_{ss} \\ \\ -\theta\frac{1-\gamma}{\psi}\bar{i} & 0 \end{pmatrix} \begin{pmatrix} n_t - n_{ss} \\ \\ \pi_t - \bar{\mu} \end{pmatrix}$$

This system has also one positive and one negative root and thus exhibits saddle-path stability.

The impact of increase in remittances on the model dynamic is summarized in the following result.

Proposition 2 *: Under a flexible exchange rate regime, an increase in remittances leads to a decrease in inflation and an appreciation in real exchange rate (there is no change in the nominal money supply, by assumption).*

Figure 4.1-b shows the phase diagram representation of model dynamic under a flexible exchange rates after an increase in remittances. Once again, suppose, that just before $t = 0$, the economy is in the initial stationary equilibrium corresponding to the point E_0 in Figure 4.1-b. At time 0, there is an unanticipated and permanent

increase in remittances, REM. How does the economy react in this case of flexible exchange rate ?

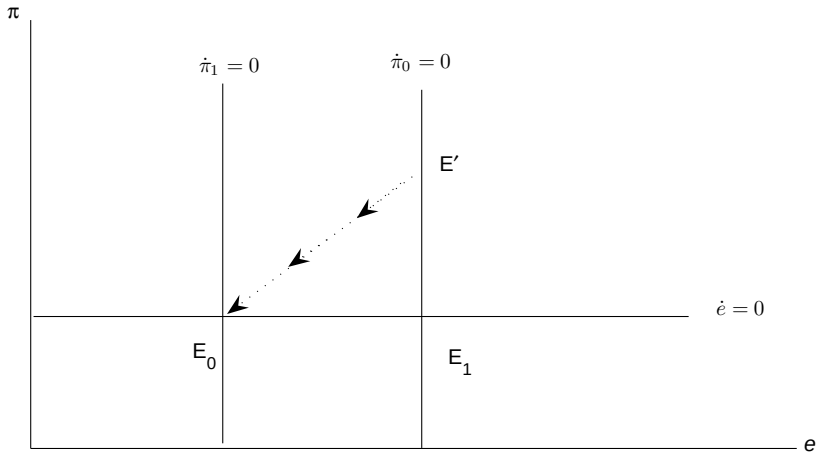
Consumption of tradable goods, given by (4.23), will increase. From equation (4.27), we can see that real money balance in terms of tradable goods (m) will be higher in the new stationary state. Given the instability of the differential equation driving the dynamics of real money balances, m must move instantaneously to its higher value.

In terms of the dynamic system, from equation (4.34) the steady-state rate of inflation of non-tradable goods, π, does not change. But from equation (4.35) the steady-state of real money balances in terms of nontradable goods, n, will be higher because the increase in remittances causes a reallocation of labor towards the nontradable sector. The initial effect of an increase in remittances is an increase in real money demanded. Under a flexible exchange rates, the central bank does not react by assumption. Since the real money balances, n, is predetermined, the inflation jumps downward to point E' in Figure 4.1-b. This induces a dynamics in nontradable prices to necessarily reach the new steady state (point E_1 in Figure 4.1-b).

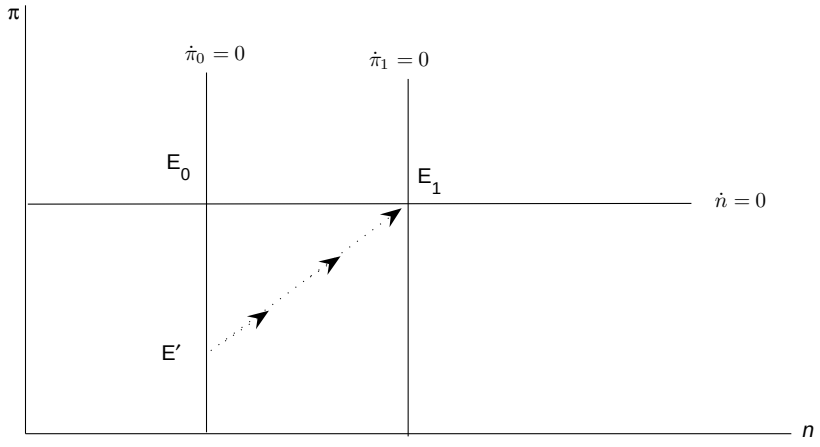
To derive the path of the real exchange rate, recall that $e = n/m$. Since m increases at time 0, e will jump down at time 0 (that is a real appreciation). During the transition, e will gradually rise back to its new steady-state level that is higher than the initial one. The effect of an increase in remittances on steady-state under predetermined exchange rates is the same as under flexible exchange rates. But,

there is different effect on the initial impact and hence the transition to the new steady-state differs across regimes.

FIGURE 4.1 – Economy's adjustment to an increase in remittances



(a): Remittances shocks under Fixed Exchange Rates



(b): Remittances shocks under Flexible Exchange Rates

To sum up, the model suggests that in the long-run the effect of remittances on

the real exchange rate is the same whatever the exchange rate regime. But in the short-run, the response of real exchange rate to an increase in remittances depends on the exchange rate regime. In response to an increase in remittances, the real exchange rate falls (real exchange appreciation) with an initial response more pronounced under a flexible exchange rates than under a fixed exchange rates.

4.3.3. Sterilization of remittances : the case of CFA Franc Zone

The discussion above assumes that monetary authorities do not intervene in exchange market to sterilize remittances flows. In practice, however, monetary authorities often care about the consequence of international capital inflows, since they will induce the real exchange rate appreciation. To deal with these undesirable consequences, policymakers intervene by selling government (or central bank) bonds to absorb this additional liquidity. This intervention in exchange market is called sterilization. In the case of full sterilization, the monetary authorities reduce domestic credit so that the monetary base remains unchanged. In the case of CFA Franc zone, the French Treasury guaranty makes easier for the monetary authorities of Franc CFA to sterilize. The autonomy of the monetary policy is achieved through the contingent credit line provided by the French Treasury, which is an instrument allowing CFA zone members to access foreign reserves (Veyrune, 2007). Through this instrument, the French Treasury guarantees the unlimited convertibility of Franc CFA at a given rate, then, reducing the need to build up reserves, and avoiding de facto widely spread capital controls. Generally, the sterilization operation could

only be effective in short run. In fact, given the relatively small size of the domestic financial market, the effectiveness of sterilization tends to reduce over time.

4.3.3. Comparison to foreign aid (Grants)

This section analyzes the response of the real exchange to foreign aid and compares with the response of real exchange to remittances. Foreign aid includes grants and loans. Grants are viewed as free resources (like remittances) and could therefore substitute for domestic revenues. Loans are different from grants because they carry the burden of future repayment. However, as highlighted by Clements et al. (2004) : "*[...] a large share of loans is provided on highly concessional terms, and loans are frequently forgiven, policymakers may come to view them, over time, as roughly equivalent to grants.*" For this reason, here, foreign aid is assimilated to grants. In the dynamic analysis, only the predetermined exchange rate is considered since the empirical analysis is about the Franc CFA zone.

The economy receives foreign grants and, for sake of simplicity, remittances are not included here. Contrary to remittances, grants are given to the government and the government can decides to transfer grants to household or to finance public goods provision. Thus, contrary to preview subsection the government can buy the two goods (tradable and nontradable goods). It is assumed here that public good is unproductive. The case of productive public good is discussed later.

The grants received by the economy in terms of tradable good is denoted by $Grants$. Let ϕ denotes the share of grants transferred to household by the govern-

ment. The new budget constraint of the household is given by

$$\dot{a}_t = ra_t + Y_t^T + \frac{Y_t^N}{e_t} + T_t + \phi Grants - C_t^T - \frac{C_t^N}{e_t} - i_t \frac{z_t}{(e_t)^{1-\gamma}} \tag{4.36}$$

Let G_t^T and G_t^N denotes tradable and nontradable goods demand by the public sector in terms of trade good, respectively. Thus, the total public expenditure is given by

$$G_t = G_t^T + \frac{G_t^N}{e_t} \tag{4.37}$$

The government's new flow constraint in terms of tradable goods is given by :

$$\dot{h}_t = rh_t + \dot{m}_t + \varepsilon_t m_t - T_t + G_t - (1-\phi)Grants \tag{4.38}$$

For simplicity the provision of public good is assumed to be financed by only grants :

$$G_t = (1-\phi)Grants \tag{4.39}$$

Thus, the government's flow constraint (4.38) can be rewritten :

$$\dot{h}_t = rh_t + \dot{m}_t + \varepsilon_t m_t - T_t \tag{4.40}$$

The equilibrium conditions in tradable and nontradable sectors change. The equilibrium in nontradable sector becomes

$$C_t^N = Y_t^N + G_t^N \tag{4.41}$$

As before, consumption of tradable good is constant over time, its level is given by :

$$\bar{C}_T = r f_0 + \bar{Y}_T \tag{4.42}$$

To analyze the effects of grants, two extreme cases can be considered. First, the government is assumed to transfer all the grants to household, i.e. $\phi = 1$. Second, all the grants are used to finance public good provision, i.e. $\phi = 0$.

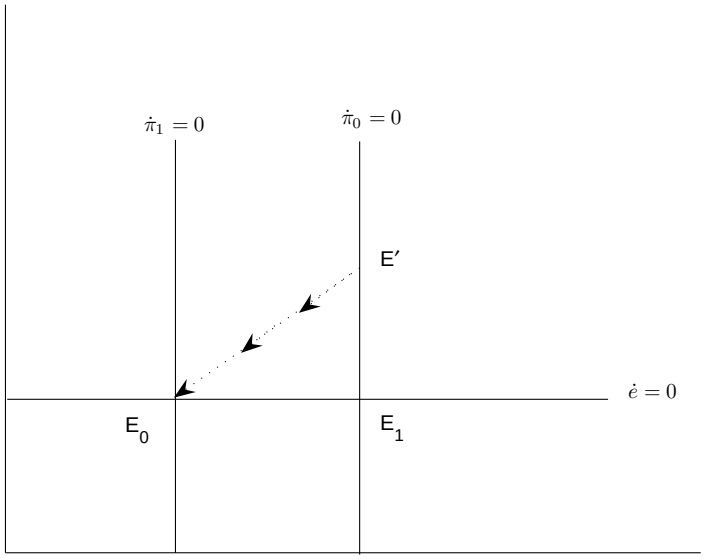
In the case where all the grants are transferred to household ($\phi = 1$), it is obvious that grants will have the same effect as remittances. In other words, if grants are used to support consumption purposes of household, grants will impact as remittances.

In the case where grants are used to finance public good provision ($\phi = 0$), the effect of grants would depend on whether public demand is oriented towards tradable sector or nontradable sector. First, assume that the government demand is oriented towards tradable sector only. In this case, imported good increase in the same proportion as grants. Thus, an increase in grants has any effect on domestic household consumption, output and real exchange rate.

Second, assume that all the grants is used to provide public sector in nontradable good. In this case, an increase in grants leads to increase in the demand of nontradable good. Since the nontradable sector is demand-determined the relative price of nontradable good increases. Since the real exchange rate, e, is predetermi-

ned, the inflation jumps up to point E' in Figure 4.2. This induces a dynamics in nontradable prices and real exchange rate to necessary reach the new steady state (point E_1 in Figure 4.2. During the transition, the real exchange rate and inflation fall continuously. The inflation in the new steady-state is the same as the initial steady-state, but, the real exchange rate is lower in the new steady-state than in the initial steady-state. The effect on the steady-state is proved in the appendix.

FIGURE 4.2 – Adjustment of economy to an increase in grants financing public provision in nontradable good



To sum up, grants have any effect on real exchange rate if grants are used to provide public sector in tradable good while grants would lead to an appreciation in real exchange if they are used to provide public sector in nontradable good. It is assumed that public good is unproductive, however, if public good is productive

the effect of grants on real exchange rate would be mitigated. On the one hand, increase in grants financing productive public good will lead to an appreciation in real exchange if grants are used to provide public sector in nontradable good. On the other hand, increase in grants financing productive public good will lead to in increase in productivity in the two sectors, leading to mitigated effect on real exchange rate [2].

4.4. Empirical evidence from CFA zone

The theoretical model suggests that, in the short-run, the response of real exchange rate to an increase in remittances differs across regimes. In response to an increase in remittances the real exchange rate falls (real exchange appreciation) with an initial response more pronounced under a flexible exchange rates than under a fixed exchange rates. So, in order to study the effect of remittances on real exchange rate on a panel framework, one needs to take into account the exchange rate regime of the countries in the sample. In general, the classification of exchange rates regime based on the publicly stated commitment of authorities is different to the classification based on the observed behavior of the exchange rate. The CFA Zone countries do not suffer from this problem of exchange rate classification. The CFA Zone is a currency union in which the monetary authorities do not make a frequent changes in the nominal exchange rate. The only change in the nominal exchange rate (devaluation) occurred in 1994.

2. See Cerra et al. (2008) for detail discussions.

The theoretical model also suggests that, if remittance inflows are sterilized by monetary authorities, the response of real exchange rate to an increase in remittances would be smaller. Besides, the theoretical model suggests that foreign aid would lead to an appreciation in real exchange rate if it is used to finance public provision in nontradable good. However, if foreign aid is allocated to productive government spending and increase in foreign aid leads to a mitigated effect on real exchange rate.

4.4.4. Econometric methodology

The dynamic specification is given by the following distributed lag model :

$$RER_{i,t} = \alpha RER_{i,t-1} + \beta X_{i,t} + \mu_i + \varepsilon_{i,t} \tag{4.43}$$

where $RER_{i,t}$ is the real exchange rate (in logarithm), $X_{i,t}$ is a set explanatory variables, including the variable of interest, remittances ; μ_i captures unobserved country-specific effects and $\varepsilon_{i,t}$ is the error term. As suggested by Arellano and Bover (1995), the country-specific effect in equation (4.43) is eliminated by using forward orthogonal deviations (as in Chapter 2). Contrary to first-differencing, forward orthogonal deviations preserves sample size in panels with gaps, and it allows finer control over the instrument matrix [3]. Let $\bar{y}_{it}$ denotes the means constructed from the future values of y_{it} a variable in the model . Let $\bar{\varepsilon}_{it}$ denotes the same thing

3. See Roodman (2009) for discussion about the benefit of the forward differencing procedure.

of ε_{it}. Then, the transformations are given by :

$$\tilde{y}_{it} = \delta_{it}(y_{it} - \bar{y}_{it}) \tag{4.44}$$

and

$$\tilde{\varepsilon}_{it} = \delta_{it}(\varepsilon_{it} - \bar{\varepsilon}_{it}) \tag{4.45}$$

where $\delta_{it} = \sqrt{(T_i - t)/(T_i - t + 1)}$ and T_i denotes the last year of data available for a given country series. For the last year of data this transformation can not be calculated, since there are no future value for the construction of the forward means. The final transformed model is thus given by :

$$\tilde{RER}_{i,t} = \alpha \tilde{RER}_{i,t-1} + \beta \tilde{X}_{i,t} + \tilde{\varepsilon}_{i,t} \tag{4.46}$$

This transformation uses an orthogonal deviation, in which each observation is expressed as a deviation of average future observations. Each observation is weighed to standardize the variance. If the original errors are not autocorrelated and have a constant variance, the transformed errors should exhibit similar properties. Thus, this transformation preserves homoscedastity and does not induce serial correlation.

In equation (4.46), the lagged forward difference in dependent variable is correlated with the error term, and the explanatory variables are potentially endogenous. Particularly, remittances can be influenced by real exchange rate of home country. Then, estimating equation (4.44) requires to use instruments. Based on the assumption that the error term is not serially correlated and that the lagged levels of the

endogenous variables are not correlated with future error terms, the GMM forward difference estimator uses the lagged levels of endogenous variables and the current level of exogenous variables as instruments.

Following Blundell and Bond (1998), this difference estimator is combined with the estimator in level to increase efficiency. Blundell and Bond (1998) show that, when the time period is short (as here), the difference estimator can be combined with an estimator in levels to increase efficiency ("system GMM"). The equation in levels uses as instruments the lagged differences of explanatory variables, provided that the error term is not serially correlated, and that the difference in the explanatory variables and the error term are not correlated.

Since the validity of instruments determines whether the GMM estimator is consistent or not, two specification tests are implemented. These tests are Hansen test of over-identifying restrictions and Arrellano and Bond's (1991) test for second-order serial correlation in the error term. The Hansen test of overidentifying restrictions has a null hypothesis that the instruments are overall valid. The Arellano and Bond's (1991) test for second-order serial correlation has a null hypothesis that there is no second-order serial correlation in the differenced error term (the residual in difference). The first-order correlation is expected in residual in difference even if the error term is uncorrelated (unless it follows a random walk). But the presence of second-order correlation is the evidence of serial correlation in the error term.

4.4.4. Data description

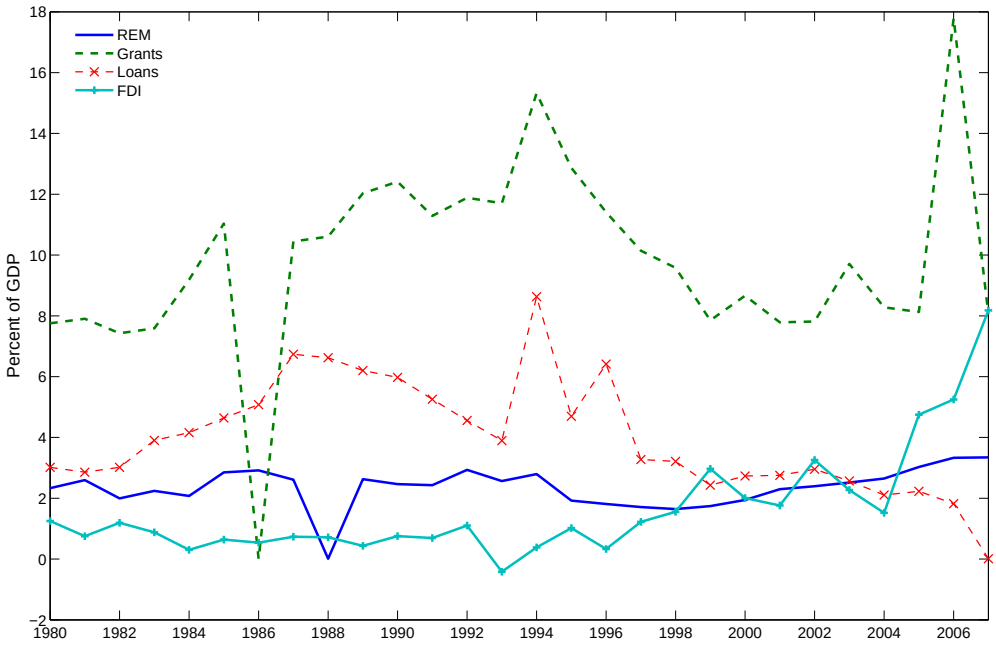
This study uses annual data for 10 countries in the CFA Franc zone over the period 1980-2007. The 10 countries in the sample are Benin, Burkina Faso, Cameroon, Congo Republic, Côte d'Ivoire, Gabon, Mali, Niger, Senegal and Togo.

Figure (4.3) shows that although remittances flows have increased significantly over the last years, foreign aid and foreign direct investment still contribute a bulk of foreign capital to CFA Franc zone. On average foreign aid inflows (grants and loans) are greater than other capital flows. During all the period 1980-2007 foreign aid inflows represent about 6 percent of GDP. Some times remittances were greater than FDI. Remittances seem to be the more stable capital inflows. On average remittances represent more than 2 percent of GDP of CFA franc zone. However, for individual country remittances represent around 6 percent of GDP. This is the case of Benin, Senegal and Togo.

The set of explanatory variables included in the model are : REM (remittances as ratio of GDP) ; $Grants$ (grants as ratio of GDP) ; $Loans$ (loans as ratio of GDP) ; FDI (foreign direct investment as ratio of GDP) GDP (real GDP per capita) ; GOV (government expenditure as ratio of GDP) ; TOT (terms of trade) ; $OPEN$ (openness of the economy defined as the sum of exports and imports expressed as a ratio of GDP) ; and DEV (a dummy variable for the nominal devaluation of the CFA Franc which takes the value of 1 in 1994 and 0 otherwise).

All variables are transformed into logarithms in the regression equation, except devaluation dummy variable.

FIGURE 4.3 – Remittances, foreign aid (grants and loans), foreign direct investment (FDI) and Non-FDI private inflows (% of GDP), 1980-2007



Source : WDI.

The expected impacts of the respective variables included in the model are as follows. As noted earlier, an increase in remittances would lead to an appreciation in the real exchange rate (Dutch disease effect). As remittances, the other international flows (foreign aid -grants and loans-, foreign direct investment) can lead to the Dutch disease effect. As mentioned above, foreign aid would lead to an appreciation in real exchange rate if it is used to finance public provision in nontradable good. However, if foreign aid is allocated to productive government spending and increase in foreign aid leads to a mitigated effect on real exchange rate. Foreign direct investment is viewed as investment compared to remittance inflows because it is tied to real investment in plant and equipment. Therefore, the degree of real appreciation from

a given increase in FDI inflows should be smaller than that associated with changes in remittances.

GDP per capita is used to proxy for productivity in order to capture Balassa-Samuelson effect. Increase in productivity leads on the one hand to a positive income effect, which through increased spending on nontradable goods tends to appreciate the real exchange rate, while on the other hand it leads to supply effect that tends to depreciate the real exchange rate. The net effect depends on the relative magnitude of the two effects. According to the Balassa-Samuelson effect, faster technological progress induces an appreciation in the exchange rate.

The effect of government expenditure on the real exchange rate will depend on the composition of public consumption. If public consumption is dominated by nontradable goods, real exchange rate would appreciate ; while if public consumption is dominated by tradable goods, real exchange rate would depreciate. This implies that the effect of government expenditure on the real exchange rate is ambiguous.

The response of the real exchange rate to changes in the terms of trade depends on whether income or substitution effects dominate. A deterioration of the terms of trade reduces real income and results in a decline in the demand for nontradable goods. In order to restore equilibrium the relative price of nontradable has to decline (real depreciation). Substitution effect causes a rise in demand for nontradable goods and, then, induces an appreciation in the real exchange rate.

As for terms of trade, the impact of trade openness, variable capturing trade restrictions, on real exchange depends on the relative magnitude of income and

substitution effects.

The nominal devaluation of CFA Franc, in 1994, is expected to lead to real depreciation.

The definition of the real exchange rate is the real effective exchange rate (REER) based on consumer prices. Precisely, REER is the ratio of domestic price level (CPI) to the trade weighted index (WPI) of foreign price level each expressed in CFA Francs. REER is calculated as $REER_i = exp\sum_{j=1}^{N} w_{ij} ln(P_j E_j)/P_i$, where P_i and P_j are the consumer price index in countries i and j ; E_j is the nominal exchange rates of countries j currency in CFA ; and w_{ij} is the is the trade weight attached by country i to country j. This is calculated as a geometric average across home country i 's N largest trading partners that make up about 70 % of total trade. The trade shares are used as weights (w_j) and have been normalized to sum to unity. In this definition, an increase in $REER$ represents an depreciation in real exchange rate.

Except the real exchange rate, data on all variables in the model is taken from the World Development Indicators of the World Bank [4]. The data on nominal exchange of CFA Zone countries trading partners is taken from the International Financial Statistics of the IMF. The values of trades weights are taken from the calculation of Coleman (2008).

TABLE 4.1 – Descriptive statistics

	RER	*REM*	*Grants*	*Loans*	*FDI*	*GDP*	*GOV*	*TOT*	*OPEN*
Mean	1.26	2.43	10.20	4.07	2.65	876.09	14.00	0.91	66.65
Std Dev.	1.61	2.45	9.39	0.04	10.11	1273.02	4.33	0.30	27.16
Min	0.16	0.03	0.00	0.00	-8.60	160.38	6.48	0.08	28.37
Max	11.38	10.55	58.59	0.38	145.20	5412.594	26.06	2.29	148.90

Notes : Estimates are based on annual data for the 10 CFA countries over the period 1980-2007. Variables are in percentage.

4. The definition of remittances is the same as in Chapter 2.

TABLE 4.2 – Correlation matrix

	RER	*REM*	*Grants*	*Loans*	*FDI*	*GDP*	*GOV*	*TOT*	*OPEN*
RER	1.0000								
REM	-0.1610	1.0000							
Grants	-0.0234	0.6196	1.0000						
Loans	-0.3069	0.4402	0.6332	1.0000					
FDI	0.1838	-0.1048	-0.0372	-0.2043	1.0000				
GDP	0.1388	-0.5703	-0.6563	-0.3860	-0.1174	1.0000			
GOV	0.0227	0.1618	0.2759	0.2053	-0.0744	-0.2020	1.0000		
TOT	-0.0078	0.0979	0.0621	0.0897	-0.1942	0.0196	-0.2415	1.0000	
OPEN	0.1011	-0.2057	-0.3976	-0.4639	0.3497	0.1733	-0.1665	-0.1833	1.0000

Notes : Estimates are based on annual data for the 10 CFA countries over the period 1980-2007. Variables are taken in logarithm.

Table 5.1 provides descriptive statistics of the variables. Table 4.2 presents the correlation matrix for the variables. Table 4.2 shows that except FDI all the other capital inflows are negatively correlated with the real exchange rate.

Table 4.3 reports the result of panel unit root test of Im, Pesaran and Shin (2003) (IPS). The results of the unit root test show (at 10 percent level of significance) that all the variables are stationary except for GDP. Then, there is no cointegration relationship between real exchange rate and the other variables.

TABLE 4.3 – Panel Unit root test

Variable	Test Stat.
RER	-1.8740 (0.0778)
REM	-2.2534(0.0850)
Grants	-4.2184(0.0000)
Loans	-1.9892 (0.0233)
FDI	-2.8190(0.0024)
GDP	0.2347(0.5928)
GOV	-2.2762(0.0114)
TOT	-1.5796(0.0571)
OPEN	-1.6810(0.0464)

The test assume that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. P-values are in parentheses.

4.4.4. Empirical results

Tables 4.4 and 4.5 present the estimations results. For robustness analysis, Table 4.4 shows the results from the OLS regressions and Table 4.5 shows the results from the GMM regression. The GMM regressions satisfy both the Hansen test of overidentifying restrictions and the serial correlation test.

TABLE 4.4 – OLS regression

	Dependent variable : RER			
	(1)	(2)	(3)	(4)
$RER(-1)$	0.926***	0.927***	0.9255***	0.925***
	(0.000)	(0.000)	(0.000)	(0.000)
REM	-0.033**	-0.027*	-0.033**	-0.033***
	(0.030)	(0.060)	(0.029)	(0.032)
$Grants$	0.034		0.033	0.033
	(0.255)		(0.280)	(0.873)
$Loans$		-1.845	-0.759	0.758
		(0.691)	(0.873)	(0.873)
FDI	0.008	0.029		0.009
	0.983	(0.940)		(0.984)
GDP	-0.007	-0.020	-0.008	-0.007
	(0.790)	(0.376)	(0.763)	(0.773)
GOV	0.125**	0.138***	0.127**	0.127**
	(0.025)	(0.014)	(0.025)	(0.026)
TOT	0.094*	0.093*	0.093*	0.093*
	(0.084)	(0.087)	(0.084)	(0.087)
$OPEN$	-0.019	-0.040	-0.020	-0.020
	(0.697)	(0.387)	(0.672)	(0.683)
DEV	0.307***	0.329***	0.309***	0.309***
	(0.000)	(0.000)	(0.000)	(0.000)
$CONSTANT$	0.685***	0.795***	0.698**	0.698**
	(0.016)	(0.005)	(0.016)	(0.018)
R^2	0.948	0.948	0.948	0.948
No of observations	210	210	210	210

P-values in parentheses. ***, ** and * denote coefficients significance at 1, 5 and 10 % level respectively

Starting with the OLS results, the regressions shows that the impact of remittances on the real exchange rate is negative and statistically significant. The coefficients of all the other capital inflows are not significant. Particularly grants nor loans has any significant impact on real exchange rate. Foreign direct investment has not also a significant impact on real exchange rate. Real GDP per capita has not a

TABLE 4.5 – GMM regression

	Dependent variable : RER			
	(1)	(2)	(3)	(4)
$RER(-1)$	0.886***	0.904***	0.890***	0.892***
	(0.000)	(0.000)	(0.000)	(0.000)
REM	-0.096**	-0.052**	-0.062**	-0.071**
	(0.022)	(0.005)	(0.093)	(0.026)
$Grants$	0.031		0.037	0.035
	(0.524)		(0.515)	(0.490)
$Loans$		6.182	7.646	7.814
		(0.560)	(0.475)	(0.477)
FDI	-0.043	0.209		0.003
	(0.911)	(0.707)		(0.995)
GDP	-0.099	0.005	-0.027	-0.044
	(0.357)	(0.968)	(0.783)	(0.622)
GOV	-0.035	-0.045	-0.041	-0.044
	(0.693)	(0.674)	(0.712)	(0.704)
TOT	0.204		0.137	0.193
	(0.210)	(0.287)	(0.199)	(0.158)
$OPEN$	0.002	-0.084	0.027	0.050
	(0.990)	(0.659)	(0.862)	(0.780)
DEV	0.292***	0.320***	0.273***	0.274***
	(0.001)	(0.000)	(0.000)	(0.000)
$CONSTANT$	1.403	0.076	3.114	0.890
	(0.270)	(0.962)	(0.516)	(0.456)
AR(1) p-value	0.022	0.031	0.024	0.027
AR(2) p-value	0.101	0.077	0.111	0.078
Hansen test p-value	0.992	0.989	0.975	0.897
No of observations	210	210	210	210

P-values in parentheses. ***, ** and * denote coefficients significance at 1, 5 and 10 % level respectively

significant impact, while government expenditure has a significant positive impact. Terms of trade have a significant positive impact, while openness has a significant negative impact. The coefficient of the devaluation term is positive and significant in statistical terms, thus implying that nominal devaluation leads to real depreciation.

Turn now our attention to the GMM regressions results. As mentioned above, this methodology could deal with the issue of endogeneity of the right hand side variables, using internal instruments. The GMM regressions results confirm the significant negative impact of remittances on real exchange exchange rate. As in the OLS regressions, the coefficients of all the other capital inflows are not significant in

GMM regressions. The non-significance of real GDP per capita -the non-confirmation of Balassa Samuelson effect- is corroborated by the GMM regressions. Contrary to the OLS regression, government expenditure and terms of trade are not significant in the GMM regression. This difference between the results two regression can be explained by the endogeneity that bias the OLS results. The GMM regressions confirm that nominal devaluation leads to real depreciation.

To summarize, the empirical results suggest that an increase in remittances causes an appreciation in real exchange in CFA Franc zone countries, while changes in other capital inflows do not affect the real exchange rate in CFA Franc zone countries. This means that, contrary to other capital inflows remittances seem to be more designed for consumption and lead to Dutch disease effect. As mentioned above, the non-significance of foreign aid can be interpreted as the fact foreign aid is allocated to productive government spending and increase in foreign aid lead to a mitigated effect on real exchange rate (Cerra et al., 2008). The non-significance effect of FDI can be viewed as the fact that FDI is tied to real investment in plant and equipment and an increase in FDI leads to mitigate effect on real exchange rate. The non-significance of government spending, terms of trade and openness can be explained by theirs mitigated effects mentioned above. The non-significance of GDP per capita (the non-confirmation of Balassa Samuelson effect) can be interpreted as the fact that global factors are driven by industrial sector that is smaller in Franc CFA Zone countries.

4.5. Conclusion

This chapter examined the link between remittances and the real exchange rate. The theoretical model shows that in the long-run the effect of remittances in the real exchange rate is the same whatever the exchange rate regime. But in the short-run, the response of real exchange rate to an increase in remittances depends on the exchange rate regime. In response to an increase in remittances the real exchange rate falls (real exchange appreciation) with an initial response more pronounced under a flexible exchange rates than under a fixed exchange rates.

In order to empirically study the effect of remittances on real exchange rate on a panel framework, data on CFA Franc countries are used. The Franc CFA Zone countries do not suffer from the problem of exchange classification. The Franc CFA Zone is a currency union in which the monetary authorities do not make a frequent changes in the nominal exchange rate. The data are annual and start from 1980 to 2007. Ten Franc CFA zone countries are selected based on data availability. Despite that the response of real exchange rate to remittances would be smaller in fixed exchange rate regime, the results show that an increase in remittances leads to a real appreciation in Franc CFA zone countries whereas changes in other capital inflows (foreign aid, foreign direct investment) do not affect the real exchange rate of Franc CFA zone countries. In other words, the study finds that, contrary to other international inflows, remittances cause Dutch disease effects in Franc CFA zone countries. Particularly, the study finds that while private gifts in the form of workers remittances do appreciate the real exchange rate, public gifts in the form of

foreign aid do not have a statistically significant impact on the real exchange rate.

The results from this study are similar to those of some previews studies that do not take into account the exchange rate regime. Amuedo-Dorantes and Pozo (2004) find empirical evidence of the real exchange rate appreciation using annual data from 1979 to 1998 for 13 Latin American and Caribbean countries. Bourdet and Falck (2006) find the same result by focusing exclusively on Cape Verde data from 1975 to 2005. López et al. (2007) used data on 20 countries and find the same evidence.

The findings of this chapter suggest that remittances would reduce the competitiveness of Franc CFA Zone countries by appreciating their real exchange rate. This implies that, in order to benefit from remittances, public authorities in Franc CFA zone countries must implement policies that orient remittances toward investment project.

This result obtained by the leading paper of Amuedo-Dorantes and Pozo (2004) has led these authors to conclude that : "*It is paradoxical that the generosity of immigrants toward their family members may, in turn, compromise their home countries' international competitiveness.*" Therefore, it is important to understand the various impacts of remittances in order to devise economic policies that help to take full advantage of these migrants gifts. The next chapter continues in this line by examining the effect of remittances on growth volatility.

Appendix

A.1. Data source

Except for real exchange rates, data on all variables in the model is taken from the World Development Indicators of the World Bank. The data on nominal exchange of CFA Zone countries trading partners is taken from the International Financial Statistics of the IMF. The values of trades weights are taken from the calculation of Coleman (2008).

A.2. Effect of an permanent increase in remittances

This section proves the effect of an increase in remittances.
Combining equations (4.9) and (4.14) gives at the steady state :

$$\alpha A^T(\bar{L}^T)^{\alpha-1} = \frac{1-\gamma}{\gamma}\frac{\bar{C}^T}{\bar{C}^N}A^N(1-\bar{L}^T)^{\beta-1} \tag{4.47}$$

Hence, using (4.23), (4.19), (4.12) and (4.13) gives

$$\alpha A^T(\bar{L}^T)^{\alpha-1} = \beta\frac{1-\gamma}{\gamma}\frac{rf_0 + A^T(\bar{l}^T)^{\alpha} + REM}{(1-\bar{L}^T)} \tag{4.48}$$

Rewriting equation (4.48) gives :

$$\bar{L}^T = \varphi^{-1}(REM) \tag{4.49}$$

$$\text{where } \varphi(\bar{L}^T) = \frac{\gamma}{1-\gamma}\alpha\beta A^T(\bar{L}^T)^{\alpha-1}(1-\bar{L}^T) - A^T(\bar{L}^T)^{\alpha} - rf_0$$

Since φ is a decreasing function ($\frac{\partial\phi}{\partial\bar{L}^T} < 0$), an increase in remittances REM leads to decrease in $\bar{L}^T$, i.e, a reallocation of labor towards nontradable sector.

Based on equation (4.14), following an increase in remittances $\bar{e}$ must fall since $\bar{L}^T$ falls. A fall in $\bar{e}$ represents an appreciation in real exchange rate. A reallocation of labor towards nontradable leads to an increase in $\bar{Y_N}$, thus, by equation (4.19), C_N will increase. By (4.9), $\bar{C_T}$ must also increase and by more than the increase in C_N.

A.3. Effect of an permanent increase in grants oriented towards nontradable sector

This section proves the effect of an increase in grants oriented towards nontradable sector. Since grants are used to only finance public spending towards nontradable sector, the effect of an increase in grants is the same as the effect of an increase in public spending towards nontradable sector

Using (4.47), (4.23), (4.41), (4.12) and (4.13) gives

$$\alpha A^T(\bar{L}^T)^{\alpha-1} = \frac{1-\gamma}{\gamma}\frac{rf_0 + A^T(\bar{l}^T)^\alpha}{A^N(1-\bar{L}^T) - G_t^N} \tag{4.50}$$

Rewriting (4.50) gives

$$\bar{L}^T = \psi^{-1}(G^N) \tag{4.51}$$

$$\text{where } \psi(\bar{L}^T) = \beta A_t^N(1-\bar{L}^T)^{\beta-1} - \frac{1-\gamma}{\gamma}\left(rf_0 + A_t^T(\bar{L}^T)^\alpha\right)$$

Since ψ is a decreasing function ($\frac{\partial\psi}{\partial\bar{L}^T} < 0$), an increase in G^N leads to decrease in $\bar{L}^T$, i.e, a reallocation of labor towards nontradable sector. Using (4.14) $\bar{e}$ must fall since $\bar{L}^T$ falls. A reallocation of labor towards nontradable sector leads to an increase in $\bar{Y_N}$, thus, by equation (4.19) C_N will increase. While a reallocation of labor towards nontradable sector leads to a decrease in $\bar{Y_N}$, thus, by equation (4.42) $\bar{C_T}$ will decrease.

Chapitre 5

Remittances, financial development and growth volatility : Do remittances reduce growth volatility ?

5.1. Introduction

Since it has been shown that volatility of GDP growth has a negative impact on growth, poverty and welfare, the literature has considered its determinants [1]. To this end, Chami et al. (2008) has examined whether remittances can help to reduce growth volatility. They argue there are multiple pathways through which remittances can impact macroeconomic volatility, and these pathways lead to contradic-

1. Economic fluctuation has a direct welfare cost for risk-averse agents, as well as an indirect one through its adverse impact on income. The negative volatility-growth relationship was established in Ramey and Ramey (1991), Ramey and Ramey (1995) and Acemogu et al. (2003), among others. The relationship between volatility and poverty is based on the fact that recessions increase poverty significantly, while expansions decrease it to a lesser extent (Agenor, 2002).

tory effects. As mentioned by Chami et al. (2008), remittances inflows help recipient households to smooth their consumption and investment over time. Therefore, large amount of remittances will reduce macroeconomic volatility in a remittance-receiving country. However, remittances may tend to increase economic volatility by changing remittance recipients' behaviors. Due to the moral hazard in terms of labor income, remittances may increase economic volatility, if in the presence of remittances, labor supply of remittance recipients becomes more procyclical. [2] Moreover, due to the moral hazard in terms of investment effort, remittance recipients will undertake riskier projects or make less effort on their existing investment projects, leading to an increase in dispersion of investments returns and hence an increase in output fluctuation.

Using a cross-section of 70 countries, comprising 16 advanced economies and 54 developing countries, Chami et al. (2008) find that remittances help to reduce growth volatility. A recent paper by Bugamelli and Paternò (2009a) has also examined whether migrants' remittances can help to reduce output volatility. Using a cross-section of about 60 emerging and developing economies they also find evidence that remittances reduce growth volatility.

This chapter considers an additional channel through which financial development can help remittances to have a stabilizing role or avoid remittances to increase growth volatility. More precisely, this chapter empirically tries to prove that a well

2. For example, due to altruistic motives, a negative productivity shock, by declining domestic income, induces an increase in remittances. In this case, remittance recipients would not increase their labor supplies in response to the shocks when remittances received are large. In fact, remittance recipients will take advantage of the remittance by increasing time allocated to leisure.

developed financial system prevents remittances to create a large GDP growth volatility. In fact, as mentioned above, remittances may have contradictory effects on volatility, by smoothing consumption and investment and by changing remittance recipients' behaviors (moral hazard in terms of labor supply and in terms of investment effort). However, well-functioning financial markets may channel remittances to non remittances-receiving agents with investment needs and allow them to smooth their investment, leading to decrease in total output volatility. Particularly, Mundaca (2009) argues that well-functioning financial markets transform remittances from remittances-receiving agents to making available resources for investment in long run projects that are usually less risky.[3] Therefore, well developed financial system may avoid remittances to be destabilizing or to be more stabilizing.

The empirical study is conducted using panel-data techniques. The sample covers 75 emerging and developing countries over the period 1980 to 2007. In order to produce the panel data, a window of five years is used to compute average statistics (mean and standard deviation). The results of this chapter show some evidence that remittances negatively affect growth volatility in environment with high level of financial development. These results hold when controlling for the potential endogeneity of remittances. Moreover, the results are corroborated by using the panel smooth transition regression (PSTR) approach recently developed by Gonzàlez et al. (2005).

The remainder of the chapter is organized as follows. Section 2 discusses the lite-

3. Indeed, one of the main roles of financial intermediaries is to provide liquidity insurance to depositors (Diamond and Dybvig, 1983), and to transform deposits by making them available for long-run investments.

rature on volatility and migrants' remittances. Section 3 describes the data used in the empirical estimation. Section 4 presents the empirical results from the standard econometric approach (panel heteroscedasticty and intrusmental variables estimations). For robustness analysis, section 5 presents the empirical results from the panel smooth transition regression (PSTR) approach. Section 6 concludes.

5.2. Related literature

An important determinant of volatility is financial development (or financing constraints - low financial development corresponding to high financing constraints). The relationship between financial markets imperfections and growth volatility was studied by many theoretical and empirical papers. Various theoretical models establish a negative link between financial development and macroeconomic volatility (e.g. Bernanke and Gertler, 1989 ; Greenwald and Stiglitz, 1993 ; Kiyotaki and Moore, 1997 ; and, Aghion et al., 1999). This theoretical finding was supported by many empirical studies (Easterly et al., 2000 ; Denizer et al., 2002 ; Raddatz, 2006 ; and Beck et al., 2006).

Easterly et al. (2000) show that, in sample of advanced and developing countries, financial development is a key factor that helps de reduce volatility. Denizer et al. (2002) show that, with data from 70 countries, countries with more developed financial sectors, experience fewer fluctuations in real per capita output, consumption, and investment growth. Basing on the differences in sensitivities to financial conditions across industries, Raddatz (2006) emphasizes that sectors with larger li-

quidity needs experience more output variability and face deeper crises in countries with underdeveloped financial systems. Finally, Beck et al. (2006) show that the impact of financial development on the propagation of shocks depends on the nature of shock (real or monetary), using data on 63 countries over the period 1960-1997. Considering the volatility of terms of trade and inflation to proxy for real and monetary volatility, respectively, they find weak evidence that financial intermediaries attenuate the influence of terms of trade volatility, and some evidence that financial intermediaries amplify the effect of inflation volatility in countries where firms have limited access to external finance.

As mentioned above, Chami et al. (2008) and Bugamelli and Paternò (2009a) contributes to this strand of empirical literature on the determinants of volatility by adding migrants' remittances to the explanatory variables of growth volatility. Using a cross-section of 70 countries, comprising 16 advanced economies and 54 developing countries, Chami et al. (2008) find that remittances reduce growth volatility. Bugamelli and Paternò (2009a) use a cross-section of about 60 emerging and developing economies and also find evidence that remittances reduce growth volatility.

This chapter contributes to the literature on the link between remittances and growth volatility by looking specifically at the interaction between remittances and the financial development. More precisely, contrary to Chami et al. (2008) and Bugamelli and Paternò (2009a), this chapter explores how local financial sector development influences the effect of remittances on growth volatility. Besides, unlike Chami et al. (2008) and Bugamelli and Paternò (2009a) that used cross-sectionnal

data, the empirical study in this chapter is conducted using panel data techniques.

The study in this chapter is also related to other previous studies. Using a dataset for remittances covering about 100 developing countries, Giuliano and Ruiz-Arranz (2009) find that remittances boost growth in countries with less developed financial systems, by providing an alternative way to finance investment and by helping to overcome credits constraints. However, within a theoretical framework, Mundaca (2009) shows that financial intermediaries help remittances to have a large effect on rate of growth. Using panel data for countries in Latin America and Caribbean, Mundaca (2009) finds evidence that confirms its theoretical result. Aggarwal et al. (2006) use data on workers' remittances flows to 99 developing countries and find evidence that remittances promote financial development in developing countries. Considering data from Sub-Saharan African countries, Gupta et al. (2009) find the same evidence that remittances promote financial development. Using a large panel of emerging and developing economies, Bugamelli and Paternò (2009b) conclude that large remittances help to reduce the probability of current account reversals.

5.3. Data

The sample includes data from 75 developing countries over the period 1980 to 2007. Countries are selected so that there are enough available data on variables considered in the empirical study. In order to produce the panel data, a window of five years is used to compute statistics (mean and standard deviation). The use of 5-year interval allows for variation over time.

The dependent variable is the volatility of growth rate of output. Following Acemogu et al. (2003), volatility of growth is measured by the standard deviation of real GDP per capita growth rate over a 5-year interval. Remittances - the variable of interest - is defined as the sum of migrants' remittances, workers' compensation and migrant transfers, and, is expressed as a ratio to gross domestic product (GDP) in order to capture the importance of remittance flows to national output. [4] Data on remittances are taken from World Bank's database (World Development Indicator (WDI)). Following Beck et al. (2006), financial development is measured by private credit, the claims on the private sector by financial intermediaries as share of GDP. As argued in Beck et al. (2006), private credit represents the most important activity of the financial intermediaries, channeling funds from savers to investors, and particularly, to investors in the private sector.

Following the previous studies, the standard deviations of terms of trade changes and inflation over the corresponding periods is used to proxy for the degree to which an economy is subject to real and monetary shocks, respectively.

The other control variables are : the real GDP per capita, the population and the index of openness. There is evidence that wealthy countries are more stable (Easterly et al., 2000). The population of an economy gives the extent to which the diversification is possible (Mobarak, 2005). In other words, larger countries have a potentially greater capacity to diversify their resources. Finally, greater openness increases a country's exposure to changes in external shocks (Beck et al., 2006). The

4. The same definition in Chapter 2 is used.

degree of openness is measured by the trade openness, i.e sum of export and import as share of GDP. This variable is the most commonly used to proxy for the degree of openness.

Remittances, financial development, openness and real GDP per capita are computed as mean over the 5-year intervals. Population represents the population at the beginning of the period. Real GDP per capita and population are taken in logarithm. A detailed data description is provided in Appendix. As remittances, data on these variables are taken from the World Development Indicators.

For the Instrumental Variables estimates, the instruments used are per capita GDP and unemployment rate in remittance-source countries ; [5] These variables capture economic conditions in host country and the capacity of host country to receive immigrant labor. The per capita GDP (unemployment rate) in remittance-source countries is measured by a weighted average of per capita GDP (unemployment rate) in the 5 OECD countries that represent the top destination countries of migrants from each of the home country. The weights correspond to the share of migration from the corresponding country to each of those 5 destination countries. Data on migration are taken OECD database on immigrants and expatriates.

Summary statistics of all the variables are given in Table 5.1. On average, remittances amount to 4.14% of GDP and range between 0.00% of GDP (Venezuela during the period 1980 to 1984) and 84.92% of GDP (Lesotho during the period 1983 to 1988).

5. See Aggarwal et al. (2006) for the use of these variables as instrument.

TABLE 5.1 – Descriptive Statistics

Variable	Mean	Std dev.	Min	Max
Growth volatility	0.03	0.02	0.00	0.11
Remittances (% of GDP)	4.15	8.44	0.00	84.92
Credit to private sector (% of GDP)	31.88	26.39	1.01	193.06
Terms of trade volatility	0.19	0.16	0.01	0.91
Inflation volatility	0.08	0.20	0.00	2.00
Trade openness	70.19	37.26	12.87	215.02
Real per capita GDP	1777.24	1804.54	137.93	8188.89
Population (in thousand)	54100	174000	41	1260000
Destination countries' GDP	22511.47	4532.25	9289.063	34459.84
Destination countries unemployment	7.04	1.73	3.58	12.33

5.4. Empirical analysis

5.4.4. Econometric methodology

In order to examine the link between remittances and volatility, the following reduced-form regression is considered :

$$Vgdp_{it} = \alpha FD_{it} + \beta REM_{it} + \Psi' X_{it} + u_i + \eta_t + \epsilon_{it} \tag{5.1}$$

where $Vgdp$ denotes the volatility of real GDP per capita growth, FD is the index of financial development and REM denotes remittances as share of GDP. X is the matrix of control variables including the volatility of terms of trade changes $Vtot$, volatility of inflation $Vinf$, real GDP per capita GDP, population POP and index of openness $OPEN$. u_i is an unobserved country-specific fixed effect ; η_t is a time specific effect and ϵ_{it} is the error term.

Equation (5.1) is first estimated on all the sample. In order to examine whether the effect of remittances on growth volatility depends on the level of financial deve-

lopment the model is estimated at different levels of financial development (below and above the median, below and above the 80th percentile).

To account for heteroskedasticity introduced by the estimation of panel data the Feasible Generalized Least Squares (FGLS) techniques is used. This method allows the estimation in the presence of heteroskedasticity across panels. The Modified Wald test for group-wise heteroskedasticity can not accept the null hypothesis of homoscedasticity. Therefore, the FGLS estimation is more appropriate.

An issue in studying the impact of remittances on growth volatility is the potential endogeneity caused by reverse causation, and measurement error. A reverse causation problem can occur because remittances can be influenced by economic conditions in the home country (see Chapter 1). If remittances are driven by altruism motives - a desire for migrants to sustain family when home economic conditions are bad - remittances inflows may increase in response to instability in home country. On the contary, if remittances are driven by self-interested motives - a desire for migrants to exploit investment opportunities in home country - remittances inflows may decrease in response to increased fluctuations in home country. There may also be a measurement error problem because officially recorded remittances are measured with error. Officially recorded remittances exclude remittances that are sent via informal channels (e.g. hawala operators, friends, and family members). In order to take into account the potential endogeneity of remittances, the model is also estimated by the Instrumental Variables (IV) method.

5.4.4. Empirical results

This section presents the regression results from 75-country panel over the period 1980 to 2008.

5.4.4. Remittances and growth Volatility

Results of the estimation of Equation (5.1) are presented in Table 5.2. Table 5.2 suggests a negative and statiscally significant impact of remittances on growth volatility. The impact of remittances is significant at 5% level. Financial development also have a negative and statiscally significant impact on growth volatility and its impact is significant at 5% level. These finding suggest that, like financial development, remittances reduce growth volatility.

The standard deviations of terms of trade changes and inflation have both a positive effect on growth volatility, with a significance at 1% level. The results also suggest that small states experience more economic instability, while income has no significant effect on volatility. Population has a negative impact that is significant at 1% level, while per capita income has a negative impact but not significant. Finally, the results show that greater openness increases economic instability with a significance at 1 % level.

5.4.4. Remittances, financial development and growth volatility

In order to test whether the effect of remittances on volatility depends on the level of financial development, Table 5.3 presents the effect of remittances on volati-

TABLE 5.2 – Remittances and Volatility

Dependent Variable : Volatility of GDP (Vgdp)	
REM	-0.0001
	(0.0000)**
FD	-0.0001
	(0.0000)**
Vtot	0.0281
	(0.0032)***
Vinf	0.0086
	(0.0026)***
GDP	-0.0001
	(0.0004)
POP	-0.0007
	(0.0003)***
OPEN	0.0001
	(0.0000)***
Heteroskedasticity test	74120.86
Chi2(75) p-value	(0.0000)
Number of countries	75
Number of observations	1621

Robust standard errors in parenthesis. Heteroskedasticity test is Modified Wald test for group-wise heteroskedasticity. Dependent variable is the standard deviation of growth in real per capita GDP. GDP, POP are taken in logarithm. Period dummies are included but not reported. ***, ** and * denote coefficient significance at 1, 5 and 10% level, respectively.

lity at different levels of financial development. The study reports the results using the threshold placed at the median, the 20th and 80th percentiles [6]. The results suggest that the effect of remittances on volatility depends on the level of financial development. In environment where financial development is low (below the median and the 80th percentile level), the impact of remittances is not significant. But, in environment where financial development is high (above the median and the 20th percentile level), the impact of remittances is negative and significant at 1% level. Moreover, the negative impact above the median is greater than that above the 20th percentile. These findings suggest that remittances reduce growth volatility in environment with high level of financial development. This result means that, well-

6. Using the 30th and 70th percentiles give the same results.

functioning financial markets, by giving information on projects returns, may direct remittances to projects that yield less risky return and therefore avoid remittances to increase growth volatility.

TABLE 5.3 – Remittances, financial development and growth volatility

Dependent Variable : Volatility of GDP (Vgdp)				
	Below median	Above median	Lowest 80%	Highest 80%
REM	0.0000	-0.0003	-0.0001	-0.0001
	(0.0001)	(0.0001)***	(0.0001)	(0.0000)***
FD	-0.0001	-0.0001*	-0.0001	-0.0001
	(0.0001)	(0.0000)	(0.0001)	(0.0000)***
Vtot	0.0147	0.0439	0.0229	0.0323
	(0.0039)***	(0.0051)***	(0.0034)***	(0.0035)***
Vinf	0.0086	0.0157	0.0147	0.0081
	(0.0048)*	(0.0036)***	(0.0039)***	(0.0024)***
GDP	-0.0001	0.0002	0.0004	0.0009
	(0.0001)	(0.0002)	(0.0005)	(0.0004)**
POP	-0.0018	-0.0004	-0.0010	-0.0005
	(0.0004)***	(0.0003)***	(0.0003)**	(0.0003)
OPEN	-0.0001	0.0001	-0.0001	-0.0001
	(0.0000)***	(0.0000)***	(0.0000)	(0.0000)***
N. of countries	53	54	67	70
Observations	819	802	1282	1291

Robust standard errors in parenthesis. Heteroskedasticity test is Modified Wald test for groupwise heteroskedasticity. Dependent variable is the standard deviation of growth in real per capita GDP. GDP, POP are taken in logarithm. Period dummies are included but not reported. ***, ** and * denote coefficient significance at 1, 5 and 10% level, respectively.

5.4.4. Instrumental Variables

As mentioned above, the endogeneity of remittances could be an issue in this empirical framework. To tackle this problem, the model is also estimated by the Instrumental Variables (IV) techniques. Following Aggarwal et al. (2006), the instruments used are : per capita GDP and unemployment rate in remittance-source countries. These variables capture economic conditions in host country and the capacity of host country to receive immigrant labor. The per capita GDP (unemployment rate) in remittance-source countries is proxied by a weighted average of per capita

GDP (unemployment rate) in the top 5 OECD destinations countries. The weights are measured by the share of migration from the corresponding country to each of those 5 destinations countries.

The results of IV estimation are reported in Table 5.4 for the full sample and Table 5.4 for the threshold sample.

In Table 5.4 - column (1), only per capita GDP in remittance-source countries is used as instrument. As expected, per capita GDP in remittance-source countries is positively correlated with remittances. The F-statistic of excluded instruments is equal to 19.27, above the rule of thumb threshold of 10 recommended by Straiger and Stock (1997) to avoid weak instrument concerns. In Table 5.4 - column (2) only unemployment rate in remittances-source countries is used as instrument and the the test of excluded instruments is equal to 36.93. As expected, unemployment rate in host countries is negatively correlated with remittances. In Table 5.4 - column (3) per capita GDP and unemployment rate in remittances-source countries are used together as instruments. In this case, the test of excluded instruments is still above 10 and the Hansen J test also proves the validity of the two instruments.

The IV estimation confirms a negative impact of remittances on growth volatility that is higher than that of FGLS. This is consistent with a positive endogeneity bias (more remittances are sent if home economic instability increases) and measurement error.

The threshold IV estimation reported in Table 5.5 corroborates the finding that the stabilizing effect of remittances is greater in environment with high level of fi-

nancial development. Contrary to the FGLS estimation, remittances reduce growth volatility in sample below the median at the 80th percentile level of financial development. This result is also consistent with a positive endogeneity bias and measurement error.

TABLE 5.4 – Remittances and Volatility :Instrumental Variable

Dependent Variable : Volatility of GDP (Vgdp)			
	(1)	(2)	(3)
REM	-0.0036	-0.0028	-0.0028
	(0.0012)***	(0.0009)***	(0.0008)***
FD	-0.0001	-0.0001	-0.0001
	(0.0000)	(0.0000)	(0.0000)
Vtot	0.0179	0.0160	0.0161
	(0.0078)**	(0.0073)**	(0.0071)**
Vinf	0.0090	0.0084	0.0084
	(0.0059)	(0.0057)	(0.0055)
GDP	-0.0066	-0.0053	-0.0052
	(0.0019)***	(0.0019)****	(0.0016)***
POP	-0.0026	(-0.0027)	-0.0027
	(0.0007)***	(0.0007)****	(0.0006)***
OPEN	0.0002	0.0001	0.0001
	(0.0001)**	(0.0001)**	(0.0000)***
N. of countries	75	75	75
Observations	1567	1567	1567
First-stage F stat.	13.85***	36.93	21.32***
(p-value)	(0.0010)	(0.0000)	(0.0000)
Host GDP	3.4102***		2.5065
	(0.9164)		(1.1900)**
Host unemployment		-0.5090	-0.3970
		(0.0838)***	(0.1021)***
Hansen overidentification			0.040
(p-value)		(0.8414)	
Anderson-Rubin F stat.	18.63	12.18	9.20
(p-value)	(0.0000)***	(0.0005)***	(0.0001)***
R-squared	0.3252	0.3785	0.3309

Robust standard errors in parenthesis. Heteroskedasticity test is Modified Wald test for group-wise heteroskedasticity. Dependent variable is the standard deviation of growth in real per capita GDP. GDP, POP are taken in logarithm. Period dummies are included but not reported. ***, ** and * denote coefficient significance at 1, 5 and 10% level, respectively.

5.5. Panel smooth transition regression approach

Using an exogenous threshold of financial development the above results show that the marginal reducing effect of remittances on growth is increasing with the level

TABLE 5.5 – Remittances, financial development and growth volatility : instrumental variable

Dependent Variable : Volatility of GDP (Vgdp)				
	Below median	Above median	Lowest 80%	Highest 80%
REM	-0.0028	-0.0047	-0.0030	-0.0033
	(0.0008)***	(0.0010)***	(0.0009)***	(0.0009)***
FD	0.0002	-0.0001	0.0000	-0.0001
	(0.0026)	(0.0000)	(0.0001)***	(0.0000)***
Vtot	0.0078	0.0481	0.0150	0.0216
	(0.0085)	(0.0122)***	(0.0076)**	(0.0091)**
Vinf	0.0024	0.0244	0.0063	0.0108
	(0.0073)	(0.0079)***	(0.0067)	(0.0060)**
GDP	-0.0054	-0.0115	-0.0053	-0.0060
	(0.0017)***	(0.0079)***	(0.0018)***	(0.0019)**
POP	-0.0029	-0.0042	-0.0033	-0.0024
	(0.0011)***	(0.0009)***	(0.0009)***	(0.0007)***
OPEN	0.0002	0.0001	0.0001	0.0002
	(0.0001)	(0.0000)***	(0.0001)	(0.0001)***
N. of countries	53	54	65	67
Observations	798	802	1128	1120
First-stage F stat.	19.27	17.56	19.72	15.42
(p-value)	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
Host GDP	5.090	3.7300	2.6168	2.8935
	(1.2522)***	(1.3133)***	(1.2673)**	(1.4692)**
Host unemployement	-0.3215	-0.1739	-0.4501	-0.3417
	(0.1411)**	(0.1369)**	(0.1073)***	(0.1173)***
Hansen overidentification	0.343	1.441	0.563	0.137
(p-value)	(0.5580)	(0.2300)	(0.4532)	(0.7109)
Anderson-Rubin F stat.	9.71	37.56	12.26	12.84
(p-value)	(0.0001)***	(0.0000)***	(0.0000)***	(0.0000)****
R-squared	0.3699	0.5083	0.3456	0.4456

Robust standard errors in parenthesis. Heteroskedasticity test is Modified Wald test for groupwise heteroskedasticity. Dependent variable is the standard deviation of growth in real per capita GDP. GDP, POP are taken in logarithm. Period dummies are included but not reported. ***, ** and * denote coefficient significance at 1, 5 and 10% level, respectively.

of financial development. This section tries to corroborate this finding by using the panel smooth transition regression (PSTR) approach recently developed by Gonzàlez et al. (2005). In the PSTR approach, the effect of remittances on volatility, depending on the level of financial development, does not sharply move between different regimes. The PSTR approach allows a smooth transition between differents regimes.

5.5.5. Threshold specification

The PSRT model with two regimes takes the following from :

$$Vgdp_{it} = \beta_0 REM_{it} + \beta_1 REM_{it} g(FD_{it}, \gamma, \delta) + u_i + \epsilon_{it} \tag{5.2}$$

The transition function is given by a logistic function :

$$g(FD_{it}, \gamma, \delta) = [1 + exp(-\gamma(FD_{it} - \delta))]^{-1}, \gamma > 0 \tag{5.3}$$

This function is continuous and bounded between [0,1]. It depends on the transition variable which is the financial development, FD_{it}, a threshold or location parameter, δ, and a smooth parameter, γ. When the parameter δ tends to infinity, the transition function $g(FD_{it}, \gamma, \delta)$ corresponds to the indicator function. In this case, the transition is sharp as a Panel Threshold Regression (PTR) model (Hansen, 1999). When δ tends to zero, the transition function $g(FD_{it}, \gamma, \delta)$ is constant and the model corresponds to a standard linear model with individual fixed effects ("within" model). The PSTR has a great advantage : it allows the effect of remittances on volatility to vary with the level of financial development. The marginal impact of remittances on growth volatility depending on the level of financial development is given by :

$$e_{it} = \frac{\partial Vgdp_{it}}{\partial REM_{it}} = \beta_0 + \beta_1 g(FD_{it}, \gamma, \delta) \tag{5.4}$$

The properties of the transition function entail $\beta_0 \leq e_{it} \leq \beta_0 + \beta_1$ if $\beta_1 \geq 0$ or $\beta_0 + \beta_1 \leq e_{it} \leq \beta_0$ if $\beta_1 \leq 0$.

The PSTR model can be generalized to $r + 1$ extreme regimes as follows :

$$Vgdp_{it} = \beta_0 REM_{it} + \sum_{j=1}^{r} \beta_j REM_{it} g_j(FD_{it}, \gamma_j, \delta_j) + u_i + \epsilon_{it} \tag{5.5}$$

where the r transition functions $g_j(FD_{it}, \gamma_j, \delta_j)$ depend on the slope parameters γ_j and on the location parameters δ_j. In this generalization, the marginal impact of remittances on growth volatility is given by :

$$e_{it} = \frac{\partial Vgdp_{it}}{\partial REM_{it}} = \beta_0 + \sum_{j=1}^{r} \beta_j g_j(FD_{it}, \gamma_j, \delta_j) \tag{5.6}$$

5.5.5. Estimation and specification tests

The estimation of the parameters in the PSTR model is performed by eliminating the individual effects u_i. The indicidual effects are eliminated by removing individual-specific means. Then, the transformed model is estimated by nonlinear least squares (see Gonzàlez et al. (2005)). The PSTR procedure is based on two steps (i) test the linearity against the PSTR model and (ii) determine the number, r, of transition function (the number, $r + 1$, of extreme regimes). Testing the linearity in equation (5.2) can be implemented by testing $H_0 : \gamma = 0$ or $H_0 : \beta_0 = \beta_1$. However, in both case, under H_0, there is an issue of nuisance parameters. To solve this issue, the transition function $g(FD_{it}, \gamma, \delta)$ is replaced by its first-order Taylor expansion around $\gamma = 0$ and to test an equivalent hypothesis in the regression based on the

Taylor expansion given by :

$$Vgdp_{it} = \beta_0 REM_{it} + \theta_1 REM_{it} FD_{it} + u_i + \epsilon_{it} \tag{5.7}$$

In Equation (5.7), the parameter θ_1 is proportional to the slope parameter γ. Thus, testing for the linearity of remittances impact against the PSTR model can be implemented by testing $H_0 : \theta_1 = 0$ in equation (5.7). Then, one can use a standard tests like the F-statistics defined by :

$$LM_f = [SSR_0 - SSR_1]/[SSR_0/(TN - N - 1)] \tag{5.8}$$

where SSR_0 is the panel sum of squared residuals under H_0 (linear panel model with individual effects) and SSR_1 is the panel sum of squared residuals under H_1 (PSTR model with two regimes). Under the null hypothesis, H_0, an approximate distribution of LM_f is $F(1, TN - N - 1)$.

The same logic is used to determine the number of transition functions (extreme regimes). A sequential approach is employed to test the null of hypothesis of no remaining nonlinearity, i.e. test whether there is one transition function or whether there are at least two transition functions, as follow :

$$Vgdp_{it} = \beta_0 REM_{it} + \beta_1 REM_{it} g_1(FD_{it}, \gamma_1, \delta_1) + \beta_2 REM_{it} g_2(FD_{it}, \gamma_2, \delta_2) + u_i + \epsilon_{it} \tag{5.9}$$

As above, the second transition function is replaced by its first-order Taylor expansion around $\gamma_2 = 0$ in order to test the linear constraints on the parameters. This Taylor expansion gives :

$$Vgdp_{it} = \beta_0 REM_{it} + \beta_1 REM_{it} g_1(FD_{it}, \gamma_1, \delta_1) + \theta_2 REM_{it} FD_{it} + u_i + \epsilon_{it} \quad (5.10)$$

In the same way as above, the F-statistic LM_f can be employed by adjusting the number of degrees of freedom. Then, the sequential procedure is as follows. Given a PSTR model with r^* transition functions, test $H_0 : r = r^*$ against $H_1 : r = r^* + 1$. If H_0 cannot be rejected, the procedure stops. Otherwise, the procedure continues by testing $H_0 : r = r^* + 1$ against $H_1 : r = r^* + 2$, and so on, until the first acceptance of the null hypothesis of no remaining nonlinearity. As mentioned in Gonzàlez et al. (2005), in order to avoid excessively large models in this sequential testing procedure, at each step, the significance level must be reduced by a constant factor $0 < \tau < 1$. As suggested by Gonzàlez et al. (2005), the value of τ is set to 0.5.

5.5.5. Results of panel smooth transition regression

The results of the PSTR estimation are reported in Table 5.6 [7]. Table 5.6 shows that the linearity hypothesis is strongly rejected. This confirms the nonlinearity of remittances impact on growth volatility, i.e. the impact of remittances on growth volatility depends on the level of financial development. Now, one needs to determine

7. The PSTR model is estimated by the Matlab package provided by Christophe Hurlin.

TABLE 5.6 – Parameter estimates for the PSTR model

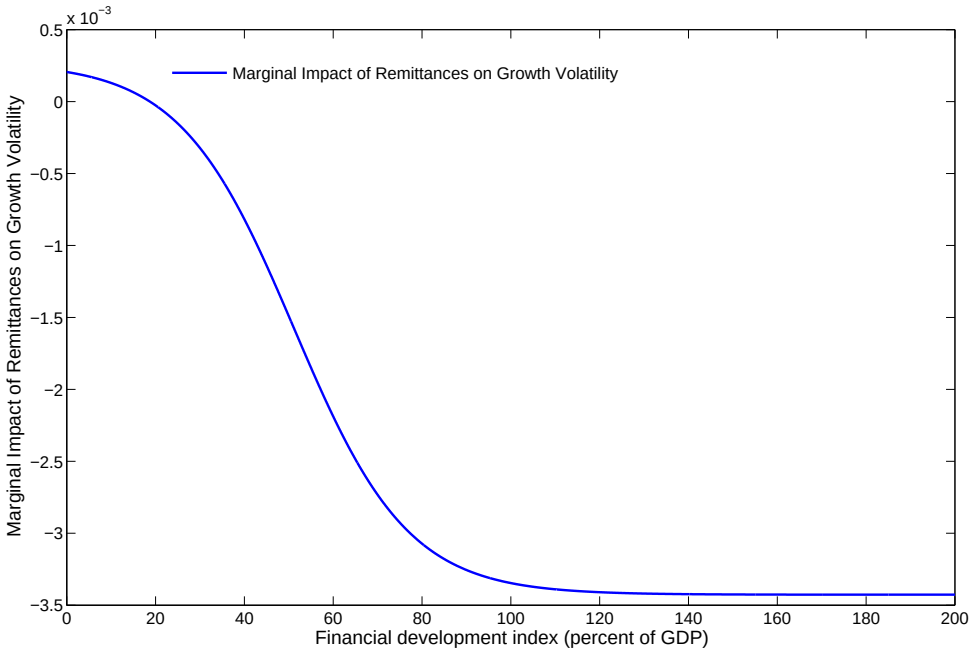
Threshold variable	FD_{it}
Fisher test of linearity	20.945
	(0.0000)
Fisher test of no	0.305
remaining nonlinearity	(0.581)
Parameter β_0	0.0003***
	(0.0001)
Parameter β_1	-0.0037***
	(0.0006)
Sum of Parameter $\beta_0 + \beta_1$	-0.0034***
	(0.0007)
Location parameter δ	51.1999
Smooth parameter γ	0.0779
Residual sum of squares	0.914

Under H_0, the test statistic has an asymptotic $F(1, TN - N - (r + 1))$ where N is the number of individuals, T the number of periods and r the number of transition functions under H_0. For F-statistics, p-value are in parentheses. For parameters, β_0, β_1 and $\beta_0 + \beta_1$, the standard errors in parentheses are corrected for heteroskedasticity. ***, ** and * denote coefficient significance at 1, 5 and 10% level, respectively.

the number of extreme regimes (transition functions) required to capture all the nonlinearity. The null hypothesis of no remaining nonlinearity is not rejected. Thus, the model requires only two extreme regimes (one transition function).

The PSTR estimation confirms the finding that remittances reduce growth volatility in environment with well developed financial system. The estimated parameters are , $\beta_0 = 0.0003$ and $\beta_1 = -0.0037$, then, $\beta_0 + \beta_1 = -0.0034$. Both parameters β_0 and β_1 are statistically significant and $\beta_0 + \beta_1$ is also statistically significant. The fact that $\beta_0 > 0$ and $\beta_1 < 0$ means that a high level of financial development is required to allow a stabilizing effect of remittances. It is possible that remittances

FIGURE 5.1 – Estimates of PSTR model



increase growth volatility when the level of financial development is very low.

Figure 5.1 displays the effect of remittances for all possible value of financial development. This figure confirms that the stabilizing effect of remittances increases with the level of financial development. The transition between the two extreme regimes is not linear but smooth. For example, when the level of financial development is below 15% of GDP, the effect of remittances on growth volatility is positive. When the level of financial development is higher than 50% of GDP, the stabilizing effect of remittances is higher than 0.0014.

5.6. Conclusion

What is the impact of remittances on growth volatility ? How does financial development influence the impact of remittances on growth volatility ? This chapter empirically answers to these questions by using panel-data for a sample of 75 countries over the period 1980-2007.

The results indicate that the impact of remittances on growth volatility depends on the level of financial development. Precisely, the results show that remittances reduce growth volatility in environment with a high level of financial development. This finding holds when the endogeneity of remittances is taken into account by using an intrumental variables estimation. Moreover, the finding is corroborated by the panel smooth transition regression (PSRT) approach recently developed by Gonzàlez et al. (2005). Indeed, the PSRT results show that, in function of the level of financial development, the impact of remittances on growth volatility moves from a first regime where remittances increase growth volatility to a second regime where remittances decrease growth volatility. In other words, a high level of financial development is required to allow a stabilizing effect of remittances.

The fact that a high level of financial development is required to allow a stabilizing effect of remittances can be explained as follows. Since less financing constraints reduce growth volatility, remittances might be then viewed as financial flows that relax financing constraint, then reduce growth volatility. However, as argued in Chami et al. (2008), with high level of remittances agents will choose riskier projects, or expend less effort on their existing investment projects, leading to an increased dis-

persion of investment returns and hence an increase in output volatility. By giving information on projects retunrs, a well developed financial system may avoid to invest remittances in risky projects and save remittances to increase growth voaltility. Thus, the stabilizing effect of remittances occurs in environment with well developed financial system.

The finding from this chapter is in a way related to the results from the study by Mundaca (2009). Within a theoretical framework, Mundaca (2009) shows that financial intermediaries help remittances to have a large effect on rate of growth. Using panel data for countries in Latin America and Caribbean, the author finds evidence that confirms this theoretical result, i.e remittances tend to enhance further growth if financial markets develop properly.

Since growth volatility negatively affects growth level, this study finds an other channel through which remittances contribute to economic growth.

The main policy recommendation of chapter is that public authorities in remittance recipient countries might implement policies that promote the financial sector in order to allow a stabilizing effect of remittances.

Appendix

A.1. Countries included in the sample

Algeria, Argentina, Barbados, Belize, Benin, Bolivia, Bostwana, Brazil, Burkina Faso, Cameroon, Cape Verde, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Ethiopia, Fiji, Gabon, Gambia, Ghana, Guatemala, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Iran Islamic Republic, Jamaica, Jordan, Kenya, Lao PDR, Lesotho, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Morocco, Mozambique, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Paraguay, Philippines, Poland, Rwanda, Samoa, Senegal, Seychelles, South Africa, Sri Lanka, St. Kitts and Nevis, St. Lucia, Sudan, Swaziland, Syrian Arab Republic, Tanzania, Togo, Trinidad and Tobago, Tunisia, Turkey, Urugay, Venezuela.

A.2. Variables and their sources

This appendix provides the definition and data sources for the variables used in the regressions that are reported in this chapter.

- GDP : Real GDP per capita ; the data source is World Development Indicators (World Bank).
- Volatility of GDP : Wihin-period standard deviation of annual in log(real GDP per capita).

– Private Credit : Claims on privates sector by financial intermediaries as share of GDP ; the data source is World Development Indicators.
– Remittances : Sum of worker's remittances, migrant transfers ; the data source is World Development Indicators.
– Volatility of terms of trade : Within-period standard deviation of the annual change in the log(ratio of import and export price index ; the data source of import and export prices is World Development Indicators.
– Volatility of inflation : Within-period standard deviation of annual change in the log(consumer price index) ; the data source of consumer price index is World Development Indicators.
– Openness : Sum of exports and imports as share of GDP that are collected from World Development Indicators.
– Unemployment rate in remittance-source countries : Unemployment of the five principal OECD recipients of migration for each country in our sample, weighted by share of total migration to these countries ; unemployment rates are taken from OECD database.
– Migration data : The source is Database on Immigrants and Expatriates (OECD).

Conclusion générale

This thesis brings four contributions to the literature on remittances, using a macroeconomic approach. The first contribution in Chapter 2 is about the macroeconomic determinants of remittances. More precisely, Chapter 2 empirically examines the response of remittances to economic conditions of host and home countries. This empirical study is conducted by employing panel VAR approach that allows to benefit from both the advantages of VAR approach and panel techniques. Annual data from 1990 to 2008 for 14 Latin American and Caribbean countries (Belize, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua and Peru) are used. These 14 countries are selected in order to consider the U.S. as the only host country, since the U.S. is the major destination of migrant from these countries. The results of this chapter shows evidence that remittances respond more to changes in economic conditions in host country than to changes in economic conditions in home country. These results in Chapter 2 have some important policy implications. First, since remittances seem to not respond to home economic conditions, if remittances-receiving countries seek to receive more remittances they should consider individual and demographic variables

(Huang and Vargas-Silva, 2006). Second, receiving countries should figure out that remittances are another channel through which host economy shocks influence their economies. This is more relevant for countries that receive a large amount of international remittances.

The others three contributions are about the macroeconomic impacts of remittances. Since none of the preview studies has considered the contribution of remittance shocks to business cycles, Chapter 3 examines the role of remittance shocks in explaining macroeconomic fluctuations. This chapter use a quantitative, stochastic, dynamic, three-good equilibrium model of a small open economy calibrated on the economy of Senegal. The other shocks are : terms of trade shocks, world real interest rate shocks, domestic productivity (exportable and non-traded) shocks. The results suggest that remittance shocks explain about 10% of the fluctuations in aggregate output of Senegal. About 20% of the fluctuations in real exchange rate of Senegal are explained by remittances. The results from Chapter 3 underline that policy makers in remittances recipient countries have to take into account remittances shocks when they seek to stabilize their economies.

Chapter 4 examines the effect of the remittances on real exchange rate using annual panel data of CFA Franc zone countries over the period from 1980 to 2007. Before conducting the empirical estimation, a simple small open economy model is used to show that the magnitude of remittances impact on real exchange rate would depend on exchange rate regime. This model also examine the impact of foreign aid (foreign public gifts) on real exchange rate. The theoretical results show that, in

the long run, the impact of remittances on real exchange rate is the same whatever the exchange rate regime. But in the short-run, the impact depends on exchange rate regime. In fact, in response to an increase in remittances, the real exchange rate falls (real exchange appreciation) with an initial response more pronounced under a flexible exchange regime than under a fixed exchange regime. The theoretical model also suggests that if remittances inflows are sterilized by monetary authorities (as it is potentially the case of CFA zone) the response of real exchange rate to remittances shocks would be smaller. Finally, the theoretical model shows evidence that foreign aid would lead to an appreciation in real exchange rate (in both the long and short runs), if it is used to finance public provision in nontradable good. On the contrary, foreign aid has a mitigated effect on real exchange rate (in both the long and short run), if it is allocated to productive government spending. Thus, the case of CFA Franc zone countries is particularly interesting because CFA Franc zone is a currency union, thus, the sample of CFA zone does not suffer from the heterogeneity of remittance impact that depends on exchange rate regime. In the empirical study, the effects of other capital inflows (Foreign Aid, Foreign Direct Investment) on real exchange rate are also examined and, thus, compared to that of remittances. The results from the empirical estimation suggest that an increase in remittances lead to an appreciation in real exchange in CFA Franc zone countries, while changes in other capital inflows (official development assistance inflows (ODA), foreign direct investment (FDI)) do not affect the real exchange rate in CFA Franc zone countries. Therefore, the results from chapter 4 show that public authorities in Franc CFA

zone countries, in order to benefit from remittances, might implement policies that orient remittances toward investment projects.

Chapter 5 brings the final contribution and, contrary to Chapters 2 and 3, is about the positive aspect of remittances. This chapter empirically studies the effect of remittances on growth volatility, looking specifically at the interaction between remittances and the development of financial system. Precisely, this chapter explores how local financial sector development influences the effect of remittances on growth volatility. This empirical study is conducted using a panel of 75 countries over the period 1980-2007. The results suggest that the effect of remittances on growth volatility depends on the level of financial development. Precisely, the results shows that well developed financial system helps remittances to be more stabilizing. This finding holds after controls for the potential endogeneity of remittance and is confirmed by the result from the panel smooth transition regression. The main policy recommendation of Chapter 5 is that, to benefit from a stabilizing impact of remittances, public authorities in receiving countries might implement policies that promote financial sector development.

Further research on international remittances is promising and should continue to investigate the other impacts of remittances on the economies of recipient countries.

Bibliographie

Adams, R. H. (2009). The Determinants of international remittances in developing countries. *World Development* 37, 93-103,

Acemoglu, D. Johnson, S. Robinson, J., and Thaicharoen, Y. (2003). Institutional causes, macroeconomic symptoms : volatility, crises and growth. *Journal of Monetary Economics* 50, 49-123.

Acosta, P. A., Lartey, E. K. K., and Mandelman, F. S. (2009). Remittances and the Dutch disease. *Journal of International Economics* 79, 102-116.

——— (2008). Remittances, exchange rate regimes, and the Dutch disease : A Panel data analysis. Federal Reserve Bank of Atlanta, Working Paper 2008-12.

Adams, R., and Page, J. (2005). Do international migration and remittances reduce poverty in developing countries ? *World Development* 33, 1645-1669.

Agenor, P. R. (2002). Business cycles, economic crises, and the poor : testing for asymmetric effects. *Journal of Economic Policy Reform* 5, 145-160.

Aghion P., Banerjee A., and Piketty T. (1999). Dualism and macroeconomic volatility. *Quarterly journal of economics* 114, 1359-1397.

Aggarwal, R., Demirgüç-Kunt, A., and Martinez Peria, M. S. (2006). Do worker's remittances promote financial development ? World Bank, Policy Research Working Paper 3957.

Agarwal, R., and Horowitz, A. W. (2002). Are international remittances altruism or insurance : Evidence from Guyana using multiple-migrant households. *World Development* 30, 2033-2044.

Alleyne, D., Kirton, C., and Figueroa, M. (2008). Macroeconomic determinants of migrant remittances to Caribbean Countries : Panel Unit roots and cointegration. *The Journal of Developing Areas* 41, 137-153.

Amuedo-Dorantes, C., and Pozo, S. (2004). Workers' Remittances and the Real Exchange Rate : A Paradox of Gifts. *World Development* 32, 1407-1417.

——— (2006a). Migration, remittances and male and female employment patterns. *American Economic Review* 96, 222-226.

——— (2006b). Remittance receipt and business ownership in the Dominican Republic. *The World Economy* 29, 939-956.

——— (2006c). Remittances and education : The Dominican case. San Diego State University, July, unpublished paper.

——— (2006d). Remittances and the health care use of populations in origin communities : evidence from Mexico. San Diego State University, February, unpublished paper.

Arrelano, M., and Bond, S. (1991). Some tests of specification for panel data : Monte

Carlo evidence and an application to employment equations. *Review of Economic Studies* 58, 277-297.

Arrelano, M., and Bover, O. (1995). Another look at the instrumental variable estimation of error-components model. *Journal of Econometrics* 68, 29-51.

Ball, C, Lopez, C., Reyes, J., and Cruz-Zuniga, M. (2008). Remittances, Inflation and Exchange Rate Regimes in Small Open Economies. University of Cincinnati, Economics Working Papers Series 2008-03.

Baxter, M., and Crucini, M. (1993). Explaining saving-investment correlations. *American Economic Review* 83, 416-436.

Beck, T. Lundberg, M., and Majnoni, G. (2006). Financial intermediary development and growth volatility : Do intermediaries dampen or magnify shocks ?. *Journal of International Money and Finance* 25, 1146-1167.

Bernanke, B., and Blinder, A. (1992). The Federal funds rate and the channels of monetary transmission. *American Economic Review* 82, 901-921.

Bernanke, B., and Gertler, M. (1989). Agency costs, net worth, and business fluctuations. *American Economic Review* 79, 14-31.

Blundell, R., and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87, 115-143.

Bourdet, Y., and Falck, H. (2006). Emigrants' remittances and dutch disease in Cape Verde. *International Economic Journal* 20, 267-284.

Bugamelli, M., and Paternò, F. (2009a). Output growth volatility and remittances.

Economica, no. doi : 10.1111/j.1468-0335.2009.00838.x.

——— (2009b). Do Workers' remittances reduce the probability of current account reversals ? *World Development* 37, 1821-1838

Calvo, G. A. (1983). Staggered prices in a utility-maximizing framework. *Journal of Monetary Economics* 12, 383-398.

Cerra, V., Tekin, S., and Turnovsky, S. J. (2008). Foreign aid and real exchange rate adjustments in a financial constrained dependent economy. IMF Working Papers 08/204.

Chami, R., Barajas, A., Cosimano, T., Fullenkamp, C., Gapen, M., and Montiel, P. (2008). Macroeconomic consequences of remittances. IMF Occasional Papers 259.

Chami, R., Fullenkamp, C., and Jahjah, S. (2003). Are immigrant remittance flows a source of capital for development. IMF Working Papers 03/89.

Clements, B., Gupta, S., Pivovarsky, A., and Tiongson E. R. (2004). Foreign aid : Grants versus loans. International Monetary Funds, Finance & Development.

Coleman, S. (2008). Estimating equilibrium real exchange rates in the Franc Zone. *Journal of African economies* 17, 600-634.

Cox, D. (1987). Motives for private transfers. *Journal of Political Economy* 95, 508-46.

Cox, D., Eser, Z., and Jimenez, E. (1998). Motives for private transfers over the life cycle : An analytical framework and evidence for Peru. *Journal of Development Economics* 55, 57-80.

Cox, D., and Jimenez, E. (1992). Social security and private transfers in a developing country : the case of Peru. *World Bank Economic Review* 6, 155-169.

Cox, D., and Rank, M. (1992). Inter-vivos transfers and intergenerational exchange. *Review of Economics and Statistics* 74, 305-314.

de la Brière, B., Sadoulet, E. , de Janvry, A., and Lambert, S. (2002). The roles of destination, gender, and household composition in explaining remittances : An analysis for the Dominican Sierra. *Journal of Development Economics* 68, 309-328.

Denizer, C., Iyigun, M.F., and Owen, A. L. (2002). Finance and macroeconomic volatility. World Bank, Policy Research Working Paper Series 2487.

Djankov, S., McLiesh, C., and Shleifer, A. (2007). Private credit in 129 countries. *Journal of Financial Economics* 84, 299-329.

Diamond, D., and Dybvig, P. (1983). Bank runs, deposit insurance and liquidity. *Journal of Political Economy* 91, 401-419.

Easterly, W., Islam, R., and Stiglitz, J. (2000). Shaken and stirred : explaining growth volatility. *In Annual World Bank Conference on Development Economics* 2000, 191-211.

Edwards, A. C., and Ureta, M. (2003). International migration, remittances, schooling : evidence from El Salvador ; *Journal of Development Economics* 72, 429-461.

Elbadawi, I., and Rocha, R. R. (1992). Determinants of expatriate workers' remittances in North Africa and Europe. *The World Bank Working Papers* 1038, 1-56.

El-Sakka, M.I.T, andMcNabb, R. (1999). The Macroeconomic determinants of emi-

grant remittances. *World Development* 27, 1493-1502.

Funkhouser, E. (1995). Remittances from international migration : A comparison of El Salvador and Nicaragua. *The Review of Economics and Statistics* 77, 137-146.

——— (1992). Migration from Nicaragua : Some recent evidence. *World Development* 20, 1209-1218.

Giuliano, P., and Ruiz-Arranz, M. (2009). Remittances, financial development, and growth. *Journal of Development Economics* 90, 144-152.

Gonzàlez, A., Teräsvirta, T., and Dijk, D. v. (2005). Panel smooth transition regression models. Stockholm School of Economics Working Paper Series in Economics and Finance 604.

Gonzalez-Konig, G., and Wodon, Q., (2005). Remittances and inequality. Department of Economics and Finance Working Papers, No EC200506, Universidad de Guanajuato.

Greenwald, B., and Stiglitz, J. (1993). Financial market imperfections and business cycles. *Quarterly Journal of Economics* 108, 77-114.

Gubert, F. (2002). Do migrants insure those who stay behind ? Evidence from the Kayes area. *Oxford Development Studies* 30, 267-287.

Gupta, S., Pattillo, C., A., and Wagh, S. (2009). Effect of remittances on poverty and financial development in Sub-Saharan Africa. *World Development* 37, 104-115.

Hansen, B., E. (1999). Threshold effects in non-dynamic panels : Estimation, testing, and inference. *Journal of Econometrics* 93, 345-368.

Higgins, M. L., Hysenbegasi, A., and Pozo, S. (2004). Exchange-rate uncertaintyand workers' remittances. *Applied Financial Economics* 14, 403-411.

Hoddinott, J. (1994). A model of migration and remittances applied to Western Kenya. *Oxford Economic Papers* 46, 450-475.

Hnatkovska, V., Loayza, N. (2005). Volatility and growth. *In J. Aizenmann and B. Pinto, eds., Managing Economic Volatility and Crises*. Cambridge University Press.

Huang P., and Vargas-Silva C. (2006). Macroeconomic determinants of workers' remittances : Host vs. home country's economic conditions. *Journal of International Trade and Economic Development* 15, 81-99.

Hysenbegasi, A., and Pozo, S. (2002). What prompts workers to remit ? Evidence using a panel of Latin American and Caribbean Nations. Unpublished, Department of Economics, Western Michigan University, Kalamazoo, MI.

Ilahi, N., Jafarey, S. (1999). Guestworker migration, remittances and the extended family : Evidence from Pakistan. *Journal of Development Economics* 58, 485-512.

Im, K., Pesaran, M. H., and Shin, Y. (2003). Testing for unit roots in heterogenous panel. *Journal of Econometrics* 115, 53-74.

Kiyotaki, N., and Moore, J. (1997). Credit cycles. *Journal of Political Economy* 105, 211-248.

Kose, M. A. (2002). Explaining business cycles in small open economies : How much do world prices matter ? *Journal of International Economics* 56, 299-327.

Kose, M. A., and Riezman, R. (2001). Trade shocks and macroeconomic fluctuations in Africa. *Journal of Development Economics* 65, 55-80.

La Porta, R., Lopez de Silanes, F. , Shleifer, A., and Vishny, R. (1998). Law and finance. *Journal of Political Economy* 106, 1113-1155.

Lartey, E. K.K. (2007). Capital inflows and the real exchange eate : An Empirical study of Sub-Saharan Africa. *The Journal of International Trade and Economic Development* 16, 337-357.

Lianos, T.P. (1997). Factors determining migrant remittances : The case of Greece. *International Migration Review* 31, 72-87.

López, H., Molina, L., Bussolo, M. (2007). Remittances and the real exchange Rate. World Bank, Policy Research Working Paper 4213.

Love, I. (2001). Estimating panel-data autoregressions, package of programs for Stata. Columbia University, Mimeo.

Love, I., and Zicchino, L. (2006). Financial development and dynamic investment behavior : Evidence from a panel VAR. *The Quarterly Review of Economics and Finance* 46, 190-210.

Lucas, R.E.B, and Stark, O. (1985). Motivations to remit : Evidence from Botswana. *Journal of Political Economy* 93, 901-918.

Mckenzie, D., and Rapoport, H. (2004). Migration and education inequality in rural Mexico. *Integration and Trade* 27, 135-158.

Mendoza, E. G. (1995). The terms of trade, the real exchange rate, and economic

fluctuations. *International Economic Review* 36, 101-137.

Minalovic, B. (1987). Remittances and income distribution. *Journal of Economic Studies* 14, 524-37.

Mobarak, A.M. (2005). Democracy, volatility and development. *Review of Economics and Statistics* 87, 348-361.

Mundaca, G. (2009). Remittances, financial market development, and economic growth : The case of Latin America and the Caribbean. *Review of Development Economics* 13, 288-303.

Orozco, M., and Fedewa, R. (2005). Leveraging efforts on remittances and financial intermediation. Report Commissioned by the Inter-American Development Bank.

Ouattara, B., and Stribl, E. (2008). Foreign aid and the real exchange rate in the CFA Franc zone. *Economie Internationale* 116, 37-52.

——— 1999. Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin for Economics and Statistics* 61, 653-670.

——— (2004). Panel cointegration : asymptotic and finite sample properties of pooled time series with an application to the PPP hypothesis. *Econometic Theory* 20, 597-625.

Raddatz, C. (2006). Liquidity needs and vulnerability to financial underdevelopment. *Journal of Financial Economics* 80, 677-722.

Ratha, D. (2007). Leveraging remittances for development. Migration Policy Institute, World Bank, Washington, DC.

Rapoport, H. and Docquier, F. (2005). The economics of migrants' remittances. *In L.,A, Gerard-Varet, S-C Kolm and J. Mercier (Eds) Handbook of the Economics of Reciprocity, Giving and Altruism*, Amsterdam : North Holland.

Ramey G., and Ramey, V. A. (1991). Technology commitment and the cost of economic fluctuations. NBER Working Paper 3755.

——— (1995). Cross-country evidence on the link between volatility and growth. *American Economic Review* 85, 1138-1151.

Rodriguez, E. R. and Tiongson, E. R. (2001). Temporary migration overseas and household labor supply : Evidence from the Philippines. *International Migration Review* 35, 709-725.

Roodman, D. (2009). How to do xtabond2 : an introduction do difference and system GMM in Stata. *Stata Journal* 9, 86-136.

Sayan, S. (2006). Business cycles and workers' remittances : How do migrant workers respond to cyclical ovements of GDP at home ? IMF Working Paper 06/52.

Stark, O. (1995). Altruism and Beyond. Oxford and Cambridge : Basil Blackwell.

Stark, O., Taylor, J., E., and Yitzhaki, S. (1986). Remittances and inequality. *The Economic Journal* 96, 722-740.

——— (1988). Migration, remittances and inequality : A sensitivity analysis using the extended Gini index. *Journal of Development Economics* 28, 309-322.

Straiger, D., J. H., Stock (1997). Instrumental variable regressions with weak instruments. *Econometrica* 65, 557-586.

Swamy, G., 1981. International migrant workers' remittances : Issues and prospects. World Bank, Staff Working Paper 481.

Taylor, J., E. , Mora, J.,Adams, R., Lopez-Feldman, A. (2005). Remittances, inequality and poverty : Evidence from Rural Mexico. University of California Working Paper 60287.

Vegh, C. (2007). Non-traded goods and relative rices. In open economy macroeconomics in developing countries. MIT press, Chapter 4. Forthcoming. http ://www.econ.umd.edu/ vegh/Book/chapters/chapter8.pdf.

Veyrune, R. (2007). Fixed exchange rate and the autonomy of monetary policy : The Franc zone case. IMF Working Paper 07/34.

Woodruff, C. M., and Zenteno, R. (2001). Remittances and microenterprises in Mexico. University of California at San Diego, unpublished paper.

Yang, D., Martinez, C. (2005). Remittances and poverty in migrants' home areas : Evidence from the Philippines. University of Michigan, unpublished paper.